

Since 1902

Popular Mechanics

How
Your World
Works

Sept. 2014

Special

Do-It-Yourself
Issue

HOW TO

MAKE



Blowing Plants p. 86



Eggs p. 88

ANYTHING



A Big Hole p. 82



Boat p. 76



Lamp p. 84



Robot p. 86



PopularMechanics.com

PLUS Detroit's Gold Mine • The NFL's New Helmets •
5 Really Fast Cars • and One Humongous Bridge



WE GO WHERE YOU GO.

PROGRESSIVE

Helping you save with every mile. Now that's Progressive.

1-800-PROGRESSIVE | PROGRESSIVE.COM

Progressive Casualty Ins. Co. & affiliates. Do not attempt.

Popular Mechanics

Contents
09.14

Other Things Popular Mechanics Has
Taught You to Make in the Past 112 Years

- **October 1911:** A flint arrowhead
- **January 1922:** An electric hairdryer
- **April 1927:** A fire extinguisher
- **March 1960:** Your own water skis
- **April 1970:** A three-stage vacation home



The Bronx Boat Builders

In one of the toughest neighborhoods in the country kids are being taught how to build wooden boats by hand—and learning a lot more.

By Michael Brendan Dougherty
page 76

A Better Battery

New batteries are going to look a lot like old batteries, only they'll cost less, last longer, and not even catch on fire.

By Erik Sofge
page 92

Chad Robertson and the Secret to Good Bread

Turns out bread has nothing to do with the ingredients. Not really. It's the curiosity it takes to use those ingredients to our ends.

By Andrew Sean Greer
page 98

WD-50 chef Wylie Dufresne teaches you how to make eggs three ways. **page 88**

HOW TO MAKE ANYTHING

LOTS OF THINGS, ANYWAY. A 36-PAGE MARATHON OF BUILDING, IMPROVING, TINKERING, AND PRODUCING AMAZING THINGS WITH YOUR OWN TWO HANDS.

A TURKEY CALL - 82 / A HOLE - 82 / FRIED CHICKEN - 83 / A LAMP - 84 / SHAVING CREAM - 85 / A FREE THROW - 86 / A PLANT THAT GLOWS - 86 / A ROBOT - 86 / LIMONCELLO - 87 / JEANS - 87 / EGGS - 88 / A PERFECT BOX - 90 / A SAFER WORLD - 96 / A CHEST OF DRAWERS - 96 / YOUR BED - 96 / A DUMBWAITER - 97 / A TOPIARY - 97 / A GREAT SANDWICH - 103 / LUMP CHARCOAL - 104 / A CAMPFIRE (TWO KINDS!) - 104 / A SAND CASTLE - 105 / A VERY SHARP EDGE - 106 / A HIT SONG - 106 / A COOLER NASA - 107

Contents



Crest Hardware & Urban Garden Center in Brooklyn, New York, a father-son operation with a resident pig out back. Our ode to hardware stores starts on page 53.



page 4 Preamble

- How to speed-read
- Popular Mechanics for kids
- Letter from the editor
- Letter from a man who really loves monsters

page 11 How Your World Works

Helmets that could save football, the perfect tailgate, a gold mine in Detroit, the key to

good ice, bridge building, and the 9/11 memorial no one talks about.

page 26 Interview

Secretary of Energy Ernest Moniz talks modern nuclear reactors and comparing your electricity bill with your neighbor's.

page 42 Great Unknowns

Deep diving, cellphone towers, and carnival rides.

page 72 It Shouldn't Take a Village to Raise a Pig

Too many people are giving too much money to strangers, all because those strangers have a plan—and a Kickstarter page. By Joe Bargmann

page 45

Cars: The Popular Mechanics Guide to Speed

Everything you need to know about going fast—and a few cars to do it in, including the BMW M3, the Lamborghini Huracán LP, and the Alfa Romeo 4C.

page 53

Skills

Special Hardware Store Edition! With tips on navigating the screw aisle and early Christmas shopping, and Ted Allen on why the best employees are the grizzled ones. Plus, the best impact drivers and the state of the flat tire.

page 70

Ask Roy

Popular Mechanics' senior home editor answers your questions about mold, wheelbarrows, and your dad's old toolbox.

page 111

The Project

A deck chair you can make with only a couple of hours and two pieces of wood. And maybe a few screws.

page 124

The Back Page

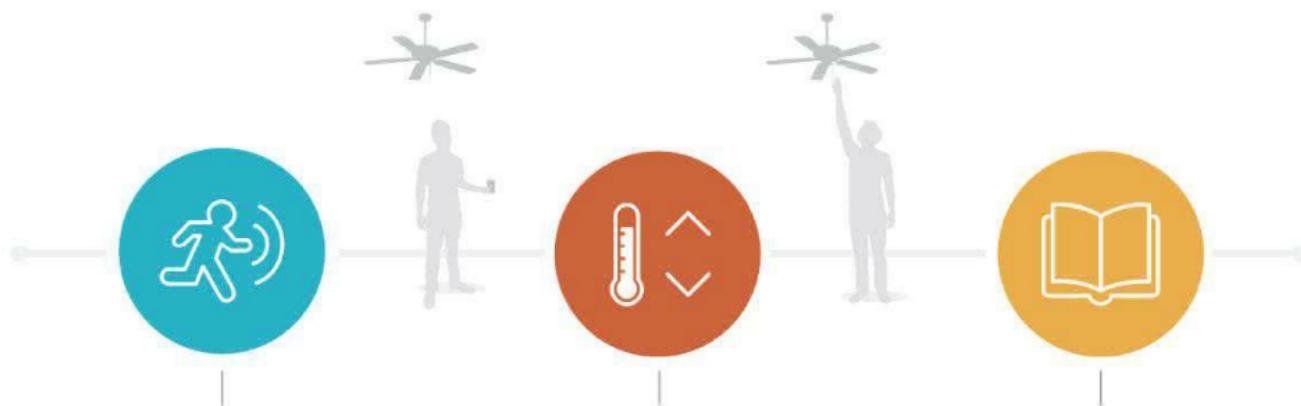
A few things you don't need to know how to make.

ON THE COVER

The CGI illustrator group Eskimo Square rendered the contents of our issue into a classic sprue, the molded plastic sheets you find in car model kits.



Introducing the Haiku® ceiling fan with SenseME™ technology.
Now the world's quietest and most energy-efficient ceiling fan is
also the smartest.



Forget the Switch

SenseME knows when you enter or leave a room, turning Haiku on and off automatically.

Forget the Pull Chain

SenseME monitors the room's temperature and humidity, adjusting Haiku's speed when conditions change.

Forget Discomfort

SenseME learns your comfort preferences, tailoring those speed adjustments to what you find comfortable.

To receive a Haiku info kit call 855-490-3043 or visit bigassfans.com/smartass and enter **PM914**.



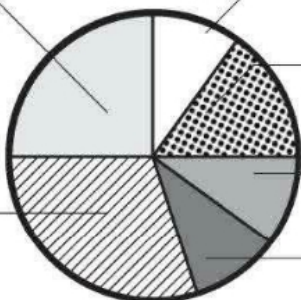
Preamble

WHAT YOU WROTE ABOUT

A highly scientific, fully comprehensive look at your response to our June issue, in helpful pie-chart form.

"The 25 Skills You Should Teach Your Kid"

Blade Orientation on Circular Saws

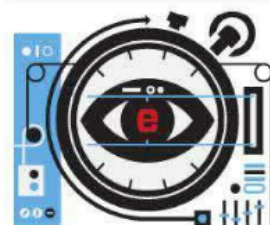


Godzilla

"What Your Phone Says About You"

"In Defense of Jargon"

The bad taste of bitterant



How to Speed-Read

After reading our review of the speed-reading app Spritz (Skills, "Do Speed-Reading Apps Work?" June), Dr. Kuni Michael Beasley, a speed reader himself, offered steps to reading faster and comprehending more:

1. **Thumb through the section you're tackling, front to back, and just look at the pages. Don't actually read anything.**
2. **Now go through backwards to get an idea of how the material is organized, noting illustrations and headers.**
3. **Thumb front to back again and, with your finger, locate bold, underlined, and italicized text and any key terms.**
4. **Go back to front one more time, locating the items you found in step 3 and read the text around them for context.**
5. **Read the regular way. You'll breeze through and comprehend more easily than if you were going in cold.**

LETTERS

OCULUS RIFT MAY NOT CAUSE MOTION SICKNESS. SORRY?

Thanks for the article on the Oculus Rift ("Total Immersion," June). I was presenting a lecture to CAE, a Canadian company that builds airline-training simulators, and they let me try out a new simulator where they re-created the effects felt by the inner ear when a plane moves. The entire cockpit enclosure was mounted on hydraulic pistons. If the "airplane" changed altitude, the cockpit moved to make you feel like you were doing a slow dive. It made me so dizzy that I had to hold on to railings and chairs for a half-hour afterward. I look forward to having an Oculus Rift someday, but I will miss that inner-ear stimulus.

BRUCE WOLLENBERG
Minnetonka, MN



ART'S FAVORITE WALL ANCHOR

You missed my favorite wall anchor in your roundup (Skills, "Anchors Array," June), the Toggler Snaptoggle. It's the best because you can remove the screw without losing the anchor in the wall.

ART PESCHKE
Royal Oak, MI

SOUNDS LIKE YOU'RE REALLY CHOPPING HAIRS HERE

The author of "The 25 Skills You Should Teach Your Kid" (June) doesn't know anything about "chopping" wood. The illustration you show is "splitting" wood. Chopping involves cutting down a tree crosswise to firewood length.

PAUL CLARK
Nevada, MO

WHAT YOUR PHONE SAYS ABOUT YOU: READER ADDENDA

You can't make assumptions about people's habits based on what phone they

Another Reason to Go to Your Kids' Ball Games

When Robert Vrabel overheard editor in chief Ryan D'Agostino telling another dad at a Little League game about this month's hardware-store story (page 53), the Iraq War vet took up his pen and crafted an ode to his own childhood store, Meeker's, in Connecticut. It was the first time Vrabel had shown his writing to anyone outside his family. We think he did a damn good job:

My kid brother and I would be tossing the baseball in the yard on a Saturday afternoon. From around the corner of the house from whatever project he was toiling with, my father called to us, "Get in the truck."

Minutes later we'd be in the back of his Chevy, my old man's hands, covered with dust and caulk, gripping the wheel bound for Meeker's Hardware.

Built in 1883, the building is a two-story red-brick structure pulled straight from a

Norman Rockwell painting. Walking through the front door was like voyaging into a bygone era. The wide, thick planks of the old wooden floors creaked with every step. The narrow aisles were filled with both familiar tools and peculiar devices made of seemingly every material imaginable. Screws and nails, knobs and dials, tubes. Hundreds of instruments, trinkets, and gadgets, the purpose of which was left to wander the corridors of my imagination.

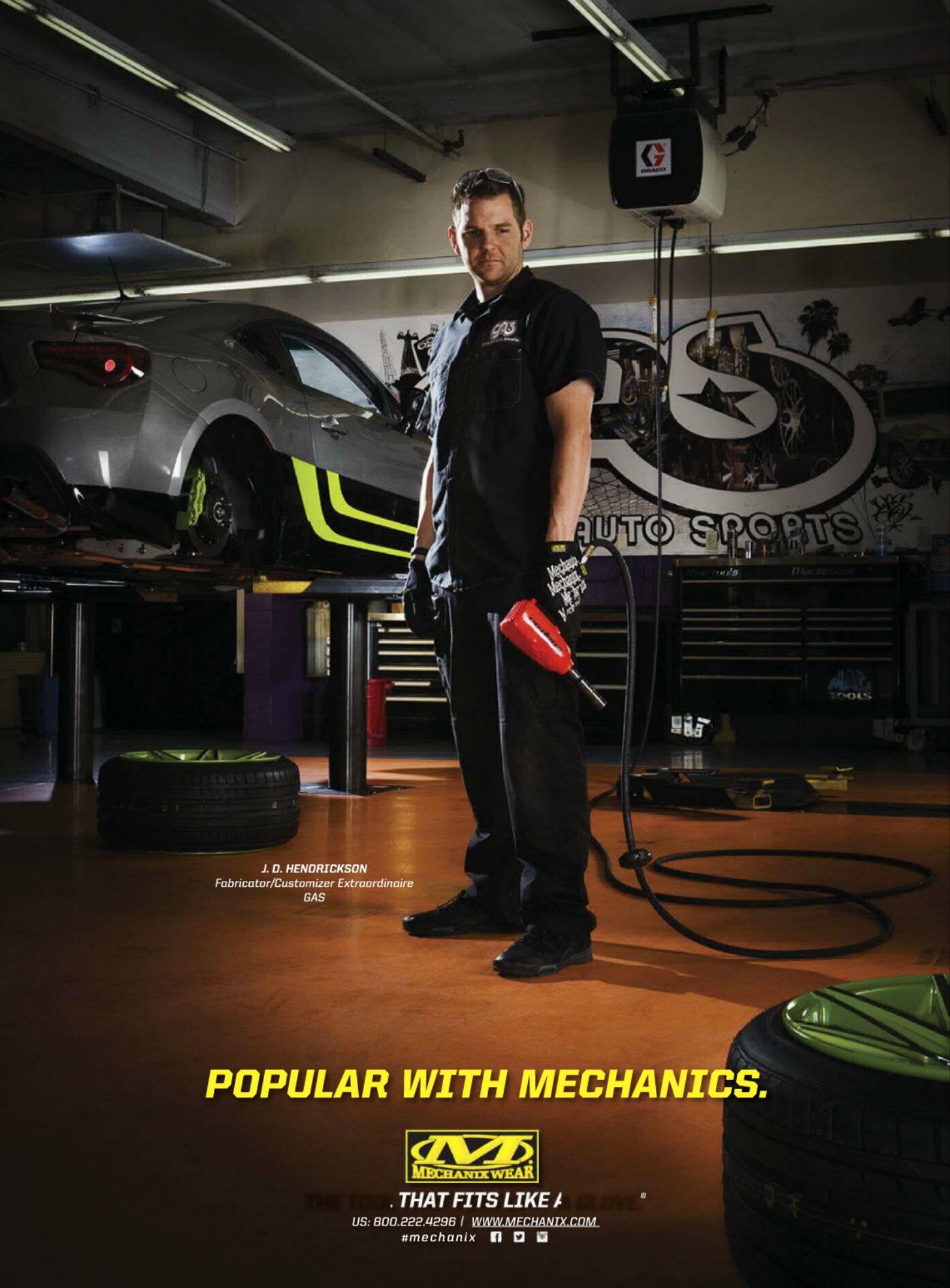
As a kid, the place felt mysterious to me, like I could sense even then its ephemerality.

Take a moment and remember your hometown hardware store. The one your dad would drag you to on a Saturday afternoon. I do. I think of Mr. Meeker

behind his old-fashioned cash register. I picture that red-brick building with white lettering painted on the side, still dignifiedly standing right off of Main Street just as it has for five generations, now empty, all its mysteries run out.



ILLUSTRATION BY ANTHONY DIMITRE



J. D. HENDRICKSON
Fabricator/Customizer Extraordinaire
GAS

POPULAR WITH MECHANICS.



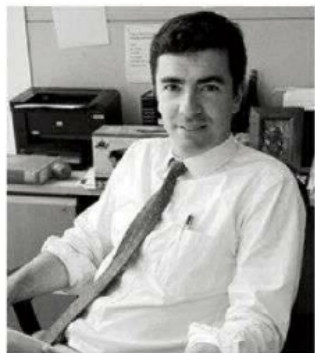
THE TOOL THAT FITS LIKE A GLOVE®

US: 800.222.4296 | WWW.MECHANIX.COM

#mechanix   

Preamble

Editor's Note



THIS IS RYAN in his office. We want to see you in your workshop. Post photos of yourself on Instagram making something, with the hashtag #HTMAasweeps. You could win the lamp on [page 84!](#)

one service Popular Mechanics has always provided, free with your subscription, is to sort through it all and help you understand which are good changes and which are destructive, and in any case how to make them work. That mission is more important now than ever.

Which brings us to me. I'm new. Here. At Popular Mechanics. I'm honored to have come aboard to steer a magazine I read as a kid—staying up late with my older brother, hunched over our new issue with a flashlight, trying to figure out how to build the motor-skateboard on [page 117](#). More recently it has saved me on multiple occasions as I renovate my 160-year-old house, trying to do some job obviously beyond my abilities.

Being here is a thrill. And we're going to make this magazine a thrill. We are trying some new stuff (the front section is now called How Your World Works, and there's a story about a baker on [page 98](#)), but sticking with what works (there's still a table of contents). We're taking seriously our job to inform you, but we also believe that understanding the world and how it works is supposed to be fun. Part of what's changing in the world is that the United States is once again becoming known as a place where people make great things. The kind of stuff that hasn't been made here since my father was a kid. (I did FaceTime with my dad the other day, incidentally—that was something new. He seemed to like it.) We intend to make heroes of engineers and brewers and woodworkers and all kinds of people who make great things. And to start we've made this issue a celebration of making: wooden boats ([page 76](#)). Robots ([page 86](#)). Glowing plants ([page 86](#)). Fried chicken ([page 83](#)). Lump charcoal ([page 104](#)). A turkey call ([page 82](#)). And next month we'll inaugurate a new monthly feature in which we showcase a single beautiful thing and the person who made it. (The clever name we came up with for that feature is: A Beautiful Thing.)

So, I hope you enjoy this issue of Popular Mechanics—after more than 1,400 in our history, my first. Our goal is that it, too, brings the thrill of a well-made thing. It has some changes (the good kind). And it is fueled on every page by what drew me to it as a kid and what I hope draws all of us to it for the rest of our days: a sense of wonder.

RYAN D'AGOSTINO,
EDITOR IN CHIEF



Popular Mechanics

SINCE 1902

Ryan D'Agostino
Editor In Chief

Design Director **Rob Hewitt**
Deputy Editor **Peter Martin**
Managing Editor **Michael S. Cain**

Editorial Director **David Granger**

Editorial
Special Projects Director **Joe Bargmann**
Senior Editors **Roy Berendsohn**,
Andrew Del-Colle,
Jacqueline Detwiler
Automotive Editor **Ezra Dyer**

Senior Associate Editor **Davey Alba**
Associate Editors **David Agrell**, **Matt Goulet**

Copy Chief **Robin Tribble**
Research Director **David Cohen**
Assistant to the Editor In Chief **Theresa Breen**
Editorial Interns **Kevin Dupzyk**, **Niko Vercelletto**

Art
Associate Art Director **Kristie Bailey**
Interactive Designer/Animator **Anthony Verducci**
Designer **Jack Dylan**

Photography
Director of Photography **Allyson Torrisi**
Associate Photo Editor **Devon Baverman**

Editorial Board of Advisers
Buzz Aldrin (Apollo 11 astronaut)
Shawn Carlson (LabRats)
David E. Cole (Center for Automotive Research)
Saul Griffith (Otherlab)
Thomas D. Jones (NASA astronaut)
Dr. Ken Kamler (microsurgeon)
Gavin A. Schmidt (NASA Goddard Institute for Space Studies)
Amy B. Smith (MIT)
Daniel H. Wilson (roboticist)
Wm. A. Wulf (National Academy of Engineering)

Imaging
Digital Imaging Specialist **Steve Fusco**

PopularMechanics.com
Online Editor **Andrew Moseman**
Online Producer **Carl Davis**
Online Associate **Darren Orf**
Online Intern **Joshua A. Krisch**

Popular Mechanics Interactive
Producer **Jeff Zinn**

Published by Hearst Communications, Inc.
Steven R. Swartz
President & Chief Executive Officer
William R. Hearst III
Chairman
Frank A. Bennack, Jr.
Executive Vice Chairman

Hearst Magazines Division
David Carey
President
Michael Clinton
President, Marketing & Publishing Director
John P. Loughlin
Executive Vice President & General Manager
Ellen Levine
Editorial Director
Gilbert C. Maurer
Publishing Consultant
Mark F. Miller
Publishing Consultant

TWENTY-FIVE YEARS OF ROY

In May, Roy Berendsohn celebrated a quarter-century as a POPULAR MECHANICS staffer. He's learned a few things in that time. His favorite: If you've got a broken pencil on a job site, sharpen it by chucking the eraser end into a cordless drill and holding a file or piece of sandpaper against the pencil lead as it turns.

Wrangler



FIVE STAR

Premium Denim

Real. Comfortable. Jeans.®

GUARANTEED

Dale Jr.
88

DALE EARNHARDT JR.
IN WRANGLER RELAXED BOOT FIT

SEE MORE OF DALE JR. AT
[FACEBOOK.COM/WRANGLERJEANS](https://www.facebook.com/wranglerjeans)

NOTHING BEATS WRANGLER COMFORT

OTHER JEANS

{ V-PATTERN PINCHES }



VS

Wrangler

{ U-SHAPE PROVIDES MORE ROOM }



AVAILABLE AT



Preamble

HAVE A DIY TIP OR A TOOL YOU LOVE?

Made something you're proud of? Mess up something you're not so proud of? Send us photos of your projects, tweaks to our instructions, or that sanding trick you learned from your dad: popularmechanics@hearst.com.

PopularMechanics

SINCE 1902

Cameron Connors

Publisher, Chief Revenue Officer

National Director, Integrated Sales
Estee Cross
Executive Director, Group Marketing
Lisa Boyars

Advertising Sales Offices

New York
Integrated Account Manager **Stephen Acunto, Jr.**
212/649-2902

Integrated Account Manager **Alex Gleitman**
212/649-2876
Assistant **Jennifer Zuckerman** 212/649-2875

Los Angeles

Integrated California Sales Manager
Anne Rethmeyer 310/664-2921
Integrated Account Manager
Amy Suprenant 949/610-0458
Integration Associate
Michelle Nelson 310/664-2922

Chicago

Integrated Midwest Director
Spencer J. Huffman 312/984-5191
Integrated Account Manager
Rikka Runyon 312/251-5355
Assistant **Yvonne Villareal** 312/984-5196

Detroit

Integrated Regional Director
Mara Filo 248/614-6055
Assistant **Toni Starrs** 248/614-6011
Hearst Magazines Sales, LLC

Dallas

Patty Rudolph 972/533-8665 PR 4.0 Media

Direct Response Advertising

Sales Manager **Brad Gettelfinger** 212/649-4204
Account Manager **John Stankewitz** 212/649-4201

Marketing Solutions

Creative Director **Glen Fuenmayor**
Art Director **George Garrastegui, Jr.**
Marketing Director **Jason Graham**
Associate Marketing Director **Bonnie Harris**
Senior Marketing Manager **Amanda Luginbill**

Administration

Advertising Services Director **Regina Wall**
Advertising Services Coordinator **Aiden Lee**
Executive Assistant to the Publisher **Ilna Bilevych**

Production

Group Production Director **Karen Otto**
Group Production Manager
Lynn Onoyeyan Scaglione
Associate Production Manager **Karen Nazario**

Circulation

Consumer Marketing Director **William Carter**

Hearst Men's Group

Senior Vice President & Publishing Director
Jack Essig
Associate Publisher & Group Marketing Director
Jill Meenaghan
General Manager **Samantha Irwin**
Executive Director, Group Strategy & Development
Dawn Shegbeby
Digital Marketing Director **Kelley Gudahl**
Executive Director, Digital Advertising
Bill McGarry
East Coast Digital Account Manager
Cameron Albergro
East Coast Digital Account Manager
Drew Osinski
Digital Account Manager **Amanda Marandola**
Digital Account Manager **Kameron McCullough**

ILLUSTRATION BY JACK DYLAN

use. (Tested, "What Your Phone Says About You," June). For example, I use Android but prefer Starbucks, *American Idol*, and Facebook. However, my music taste is eclectic.

KEN WILLIAMS
Cambridge, MA

In my case, I watch *Ancient Aliens*, drink almond milk, listen to smooth jazz, and my social media is Facebook. Yet I use an Android phone.

STEPHEN PELL
Athens, TN

WHY DO WE SUDDENLY FEEL LIKE WE'RE IN A SENIOR COLLOQUIUM AT BROWN?

Your article "The 25 Skills You Should Teach Your Kid," (June) is gender non-specific, but the cover line ("25 Skills Every Man Should Know by the Age of 25") indicates that this knowledge is passed down from fathers only. Mechanics—as a vocation or skill—need not be restricted by gender. Rather, my money is on the bylined women in the magazine and their ability to transfer those 25 skills to their daughters and sons.

JOHN PERO
North East, PA

THAT'S OKAY, THANKS

I really liked your article about Godzilla (Launch, June). Why not make a special issue about all of the monsters?

Megaguirus, Mothra, King Ghidorah . . .

MAX WHEELER
Dover, AR

Letters to the editor may be emailed to popularmechanics@hearst.com. Include your full name and address. Letters may be edited for length and clarity.

Subscribe

subscribe.popularmechanics.com
800-333-4948

The Popular Mechanics "How to Make Anything" Sweepstakes. This sweepstakes is in no way sponsored, endorsed or administered by, or otherwise associated with, Instagram or Facebook. You understand that you are providing your information to Sponsor and not to Instagram or Facebook. Sponsored by Hearst Communications, Inc. Two ways to enter, beginning July 30, 2014 at 12:01 AM (ET) through September 10, 2014 at 11:59 PM (ET): Entrant must follow Sponsor's Instagram feed at @popmech, follow the online instructions to upload and submit a photo reflecting your Do It Yourself project with hashtag #HTMAAsweeps; or enter your photo via email at HTMAAsweeps@PopularMechanics.com, including your name, date of birth, address and telephone number. If you do not have an Instagram account, you can sign up for one for free either at your mobile phone app store or at www.instagram.com. One (1) winner will be selected to win a Minimalist Lamp by Meriwether of Montana, ARV \$145. Odds of winning will depend upon the total number of eligible entries received. Important Notice: You may be charged for visiting the mobile website in accordance with the terms of your service agreement with your carrier. Entrant must have reached the age of majority and be a legal resident of the 50 U.S., the District of Columbia or Canada (excluding Quebec). Entrants by Instagram must have their settings set to public. Void in P.R. and where prohibited by law. Sweepstakes subject to complete official rules available at <http://www.popularmechanics.com/HTMAgiveaway>.



POPULAR MECHANICS, FOR KIDS

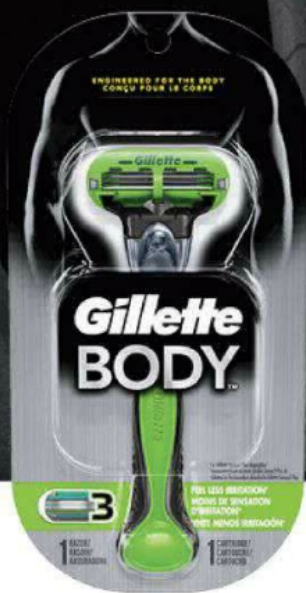
What is the smallest rocket that can go into orbit? Could a sounding rocket do it?

ALEX H., AGE 14
Hamilton, MT

When it debuts later this year, the new SPARK system of rockets will measure approximately 62 feet—rivaling the 70-foot Falcon 1 as one of the smallest rockets capable of reaching orbit. But it's really more about speed than size. According to Philip Eberspacher, chief of NASA's Sounding Rockets Program, a rocket has to reach a horizontal speed of 17,500 mph at an altitude of 200 miles in order to remain

in orbit. Most smaller options just can't pack enough power into their compact frames. Sounding rockets, by definition, can't make it to orbit. They're classified as suborbital rockets and aren't equipped to surpass the speed threshold. Even NASA's biggest sounding rocket could only reach a horizontal speed of 7,000 mph—less than half of what it would need to stay in orbit.

INTRODUCING THE FIRST RAZOR BUILT FOR THE MALE TERRAIN



A ROUNDED HEAD
FOR TRICKY SPOTS

3 LUBRICATING STRIPS
FOR MORE GLIDE

AN ANTI-SLIP GRIP
FOR ULTIMATE CONTROL

Gillette®

THE BEST A MAN CAN GET™



50% EASIER TO LIFT LINERS

The BRUTE® makes what was once backbreaking work easy with built-in venting channels that prevent the liner from sticking and cinches that keep the bag from falling in. It's innovation your workers (and their backs) can appreciate.



BUILT IN VENTING CHANNELS



CINCHES KEEP BAG FROM FALLING IN



BRUTE

HOW YOUR WORLD WORKS



STUNT PLANES!

WEATHER!

A NEW CAMERA!

DETROIT

SOFT PADDING
THAT HARDENS
ON IMPACT

AIR-FILLED SHOCK
ABSORBERS



A CHIN STRAP THAT
CINCHES AROUND THE
BASE OF THE HEAD

▲ Cross
section of
the new
Xenith Epic

THE SAVIORS OF FOOTBALL

Or, to be precise, football players. This season, new helmet technology may mean fewer concussions in college and the NFL.

SPORTS



F

For the past couple of years it's been hard to ignore: Football hurts football players. And not in the sore-knee, it'll-take-a-little-longer-to-get-out-of-the-lounger-when-I'm-retired kind of way. More in the way of Jermichael Finley, who had one hit end his 2013 season—and almost his ability to walk. Or worse, in the way of Junior Seau, whose chronic brain damage is widely suspected to have led to his suicide in 2012.

But there is hope. Last year was already big for the NFL in terms of safety. The league put independent neurologists on sidelines, banned high-risk tackles, and pledged more than \$765 million to help retired players and fund medical exams and research. Helmet manufacturers are making improvements too,

thanks in large part to Dr. Stefan Duma, head of Biomedical Engineering at Virginia Tech. Duma and his team developed a five-star rating system that subjects helmets to 120 various impacts, simulating the types of hits a player might take during a game. In 2011, when the first ratings were released, only one helmet received five stars. This year nine did. Here are four of the most promising being used in the NFL and college this fall.

RAWLINGS NRG Tachyon

It doesn't matter how well a helmet is made if it doesn't fit right. To achieve a custom fit in the past, many helmets had inflatable bladders built into the padding. But as you pumped them up, their flat surfaces became round, reducing the contact between the player and the padding, increasing pressure on a smaller portion of the skull. The Tachyon fixes that problem by reversing the direction of the bladder bulges—against the helmet, not the skull.

SCHUTT Vengeance VTD

It may be illegal to lead with the crown of your helmet, but the crown still takes a majority of hits. Knowing this, Schutt rethought the padding pattern on its helmets, adding a double layer of cushioning to the crown and reducing it in areas where it isn't as crucial. The result is a hel-

The number of concussions in the NFL increased 61% between 2005 and 2012, from 165 to 265. And that's just the ones that were properly diagnosed and reported.



met that weighs less yet still provides superior protection where it matters most.

XENITH Epic

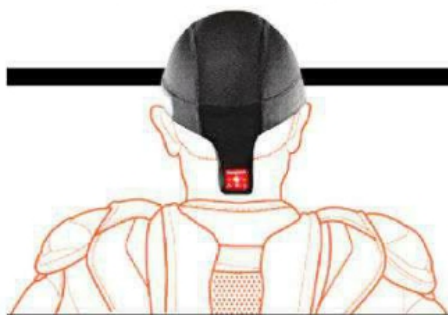
Along with resizing and repositioning pads to better mimic the shape of the skull, Xenith uses a system of air-filled shock absorbers that provide variable resistance based on the intensity of impact. Between the shock absorbers and the player's head is a material called Poron XRD. It's soft to the touch but hardens on impact, thanks to molecules that lock into place when subjected to force.

Which means padding that used to be simply for comfort now provides protection too.

RIDDELL SpeedFlex

The SpeedFlex is the first helmet not to have a fixed outer shell. Instead, a cantilever on the crown bends like a hinge upon impact (the face mask is similarly flexible), lengthening the duration of hits and lowering acceleration—effectively dispersing energy throughout the helmet instead of transferring it directly to a player's head.

— KEVIN DUPZYK



A DOCTOR ON YOUR HEAD Last year Reebok released the CheckLight, a skullcap with built-in sensors that detect and report the severity of impacts. When a player takes a big hit, the CheckLight display that hangs out from under his helmet flashes yellow or red, depending on intensity. If it's red, a coach knows to have the player checked out. If it's yellow, well, he can probably walk it off. Until the sport can actually stop concussions, at least this way teams will have a better idea of when they happen.



WHEN WE ALL
COME TOGETHER
CANCER DOESN'T STAND
A CHANCE

FRIDAY, SEPT 5th
8PM / 7 CENTRAL

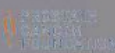
THE STARS



WILL ALIGN



GO TO STANDUP2CANCER.ORG



CANADIAN BREAST CANCER FOUNDATION, CANADIAN CANCER SOCIETY, CANADIAN INSTITUTES OF HEALTH RESEARCH, CANCER RESEARCH INSTITUTE, CANCER STEM CELL CONSORTIUM, FARRAH FAWCETT FOUNDATION, FIFTH THIRD BANK, FOX FAMILY CANCER RESEARCH FUNDING TRUST, GENOME CANADA, LAURA ZISKIN FAMILY TRUST, LUSTGARTEN FOUNDATION, MELANOMA RESEARCH ALLIANCE, NATIONAL OVARIAN CANCER COALITION, ONTARIO INSTITUTE FOR CANCER RESEARCH, OVARIAN CANCER NATIONAL ALLIANCE, OVARIAN CANCER RESEARCH FUND, ROOMKEY.COM, SEAN PARKER FOUNDATION, SIEMENS, ST. BALDRICK'S FOUNDATION

STAND UP TO CANCER IS A PROGRAM OF THE ENTERTAINMENT INDUSTRY FOUNDATION (EIF), A 501(C)(3) CHARITABLE ORGANIZATION. IMAGES FROM THE STAND UP TO CANCER 2012 SHOW. THE AMERICAN ASSOCIATION FOR CANCER RESEARCH (AACR) IS STAND UP TO CANCER'S SCIENTIFIC PARTNER.



THE ONE-SEAM JACKET

Fall's best hiking jacket is missing something important: the seams. We couldn't be more grateful.

Outdoor-gear manufacturers make big bones of their latest high-tech fabrics, going so far as to give them names that would be better suited to Spider-Man villains: Climalite, Spylon, Omni-Freeze. But there's only so far fabric itself can take an all-weather jacket. So they had to start messing with the seams.

Over the past decade seams have come a long way. The technology that protects them from wind and water became so nearly perfect that the only better option would be to have no seams at all.

That's pretty much what The North Face has done. The Fuse Uno alpine climbing shell (\$399) is constructed out of a single piece of fabric, like a really expensive origami crane. Instead of affixing sturdier fabrics at stress points, the company uses different threads when sewing different parts of the same piece of fabric, going back over the base material to weave in tough Cordura nylon.

With no more seams, there's no more need for seam tape. And with no tape, the Fuse Uno is 20 percent lighter than any jacket The North Face has made before, which should make all those zippers *very* nervous.

THE
NORTH
FACE



IF WE MAY . . .

Please, a word about this fall's great lightweight jackets: Don't buy a technical mountaineering shell unless you're a mountaineer. Unlike on the Uno, the pockets of technical mountaineering jackets have been moved up so as not to interfere with a climbing harness. They're nearly nipple height, which is entirely uncomfortable to anyone who wants to put his hands in his pockets without forcing his shoulders into contact with his cheeks.



DANIEL STEIGER

**LAZER
BLUE**

By Daniel Steiger

“THE NEXT GENERATION OF HYBRID” ...AND UNDER \$100

Timepieces USA brings you the incredible Daniel Steiger Lazer Blue Watch. Quite simply the best looking hybrid watch on sale! What's so incredible about the Daniel Steiger Lazer Blue? As well as having an ultra modern look and style this amazing watch is packed full of features and functions and is available in 18k Yellow Gold fused two tone and classic steel coloured version. This fantastic watch features a metal case structure, digital format windows showing 24hr, days of the week and seconds, with an easily accessible alarm system. This incredible watch is robust enough for those always on the move, and yet made with comfort in mind with a modern sporty look. But perhaps the most stunningly cool feature of this astonishing timepiece is its lense. The Lazer Blue Crystal gives this magnificent watch a truly unique look. Integrated into the crystal itself the Blue Lazer colouring takes the look of this watch to another level. The level of AWESOME! What else is awesome about this fantastic watch, quite simply its price. At an incredible \$99 (plus shipping and handling). This is a unique buying opportunity not too be missed! Limited stocks available.

- Lazer Blue Crystal Face
- Luminous Markers & Hands
- Two-Tone 18K Gold Plated
- Alarm & Stopwatch
- Digital & Analogue Displays
- Magnificent presentation case included
- Water-Resistant To 3 ATMs
- Backlight Display
- Seconds Display
- Day Indicator
- Metal Band
- 5 Year Unlimited Movement Warranty



CALL NOW TOLL FREE 24/7 ON 1-877 550 9876

Available In Steel Color

Quote Code **POM148LZB or go to www.timepiecesusa.com/pom148**

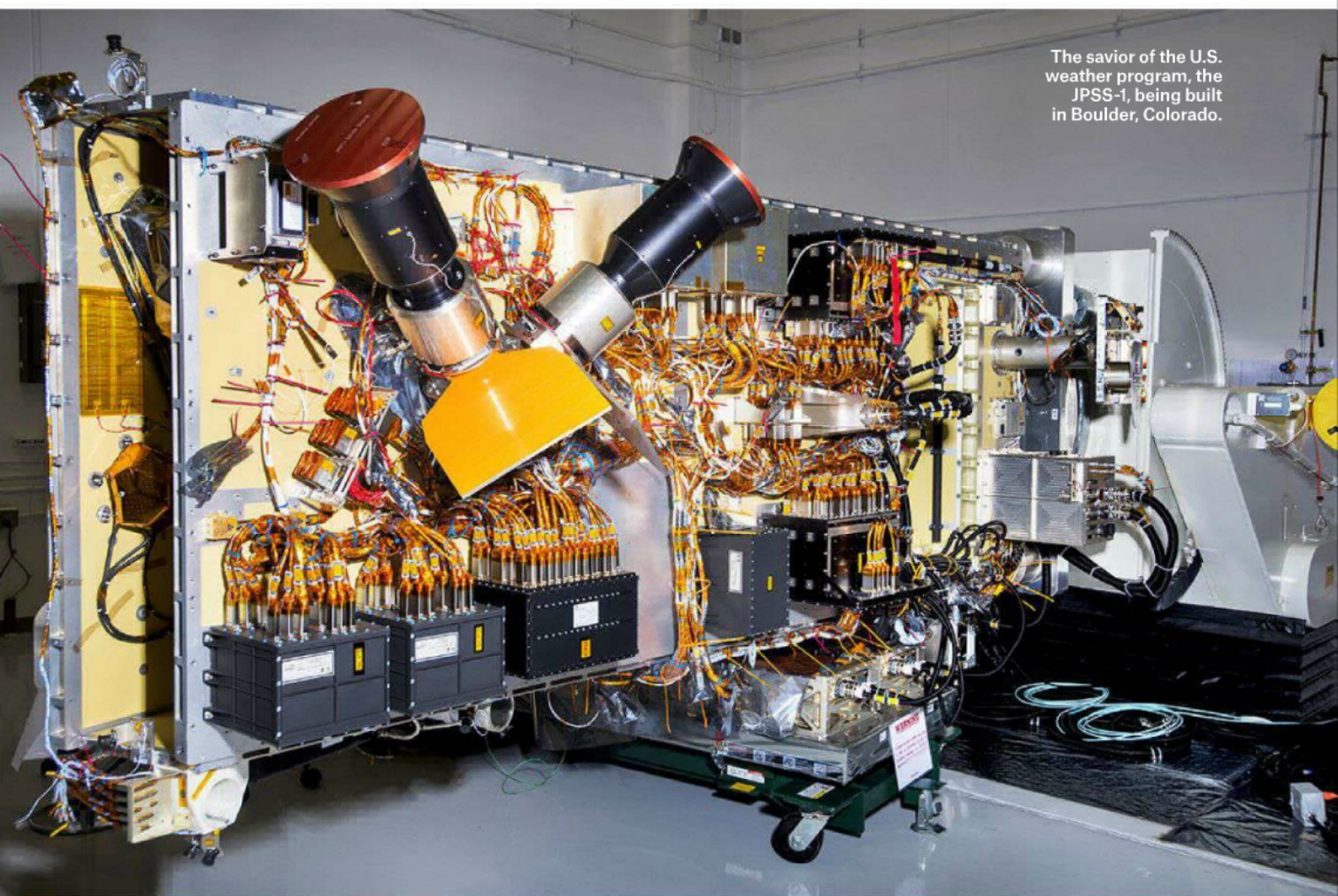
Timepieces International Inc, 3580 NW 56th Street, Fort Lauderdale, Florida, 33309

Limited Stock Available

ENTER CODE BEFORE CHECKOUT FOR PROMOTIONAL PRICE

30 Day Money Back Guarantee

WEATHER



The savior of the U.S. weather program, the JPSS-1, being built in Boulder, Colorado.

THE WEATHER GAP

The satellites we use to predict the paths of snowstorms and hurricanes are nearing the end of their lives, and a replacement won't be fully operational until 2018. Which is a problem.

BY KATHRYN MILES

When Superstorm Sandy nearly sank New York City two years ago, we knew it was going to happen. Same with snowmageddon in 2010: D.C. got more snow than a Saskatoon Christmas, and, again, we knew it was going to happen. Those were both devastating storms, but we were as prepared for them as we could have been, thanks to two very important satellites. Now, however, as superstorms become more frequent, those two very important satellites are running out of time.

To pull together your five-day forecast, meteorologists rely on two types of satellites. The first sits 22,000 miles up, capturing basic information on a

fixed location. The second orbits the poles, 500 miles up, filling in crucial image gaps and, more important, providing essential information about cloud formation, surface temperatures, and atmospheric conditions—the data that help us know where a storm is heading and how big it will be when it gets there.

Those polar-orbiting satellites, a primary and its backup, are the ones in crisis. The primary satellite—a short-term pathfinder built to test emerging technologies—was never really intended for use. Its backup isn't much better: an aging satellite with failing sensors that passed its predicted life expectancy last year. We would send up a replacement now, but it's still being built. When it is ready, should it survive launch, it

BALL AEROSPACE

could take until as late as 2018 to transmit usable data. Which means that, depending on when our current satellites stop working, the U.S. could be without crucial data for years. That's worse than inconvenient. It could cost us trillions of dollars, and hundreds, if not thousands, of lives.

It didn't have to be this way. It didn't used to be: For most of the 1970s and '80s a partnership between NASA and the National Oceanic and Atmospheric Administration ensured that we always had two fully operational birds flying, with a backup in the barn. It was, says James Gleason, senior NASA scientist, a golden age. That all changed in 1994, when President Clinton tried to cut costs by combining the NOAA and Department of Defense weather-satellite programs. The marriage was doomed from the start. Both organizations came with top-heavy bureaucracies and their own specific needs. Together they formed a dysfunctional agency defined by budget overruns, infighting, and passive-aggressive stalemates. In all the turmoil, work on any new satellites slowed to a crawl, and any surplus dried up. By the time President Obama separated the two organizations in 2010, NOAA had to scramble to pull together a new program. As a stopgap, it sent up the only option left, our current satellite—that demonstration model, with a life span of only three to five years.

Gleason predicts that the satellite's spacecraft will last long beyond that span. But those instruments. NASA

SHOULD THE VITAL NEW WEATHER SATELLITE EXPLODE, WE'RE STUCK WAITING FOR THE NEXT VERSION. SCHEDULED DATE OF COMPLETION: 2022.

engineers have what he calls serious uncertainties regarding them. Three were developed under the previous satellite program, which means they didn't undergo NASA's rigorous review process. (A U.S. Government Accountability report called the workmanship of these instruments "poor.") When private-sector and government scientists are asked about them, they literally knock on wood.

The best-case scenario has them knocking for years. And although engineers at Ball Aerospace and Technologies in Boulder, Colorado, are currently putting the finishing touches on a replacement, NASA doesn't expect it to be launch-ready until 2017. Even after launch it'll take another year of testing before the satellite is fully opera-

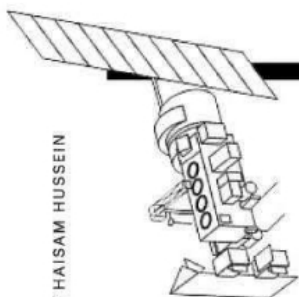
tional. And that's if it doesn't explode. "That's just a fact of life," Gleason says. "We could have a really bad day on the launch."

That's where we get into trouble. Should the new satellite explode (or just fail—a distinct possibility, considering satellites' high early-mortality rates), we're stuck waiting for the next version. Scheduled date of completion: 2022.

If that happens, NOAA has proposed a variety of mitigation plans, from targeted jet missions to private and international outsourcing. The federal government recently signed agreements with Japan, Canada, and Europe to secure support in the case of catastrophic satellite loss, but there are no guarantees those programs will provide the data we need—or that we can afford them.

The most comprehensive solution happens to also be the one that upsets the most people: The Chinese currently have two polar orbiting satellites in commission and they're about to launch a third. But since the Chinese weather program is tied directly to its military—and since, you know, it's China—the idea of buying data from them has sparked more than a small firestorm on Capitol Hill.

Whatever the solution, we need to decide on one. Quickly. Meteorologists want to predict the weather with the best tools available, and that's getting harder every day. They know that another Sandy or snowmageddon is inevitable. It's just no longer a given that we'll see it coming.



THE BOCA RATON OF SPACE

When old satellites retire, here's how we send them off.

1. Every decommissioned satellite burns its remaining fuel and shuts down any solar-charging capabilities to prevent explosions that could result in space debris, which is dangerous to functioning satellites and, occasionally, Sandra Bullock.

2. Next, engineers end signal transmission, which might interfere with other satellites, and turn off the main computer.

3. Distant satellites, such as the geostationary ones that sit about 22,000 miles up, have orbits that decay very slowly,

dragging the spacecraft ever closer to Earth. Even though it would take centuries before they hit the ground, these satellites usually get boosted into a higher "parking" orbit to get them out of the way.

4. For satellites that are closer to

Earth, such as the polar-orbiting weather satellites in this story, there are two options: Older ones aren't able to maneuver on their own, so the government tracks them until they drop into the atmosphere and burn up. Newer

satellites, however, are equipped with thruster rockets, which are used to make a controlled reentry into the atmosphere. Whatever doesn't burn up lands in the ocean and sinks, hopefully not being eaten by cute seals on the way to the bottom.

WeatherTech®

Automotive Accessories



FloorLiner™

Provides "absolute interior protection"™

Laser measured to perfectly fit your vehicle

Has channels to carry fluids and debris to a lower reservoir

Material provides soft touch top, rigid core strength and bottom surface friction



Available in Black, Tan and Grey for over 900 applications

All-Weather Floor Mat



Underside Nibs and Anti-Skid Ridges



Ribbed Design

Deep sculpted channels designed to trap water, road salt, mud and sand

Will not crack, curl or harden regardless of temperature

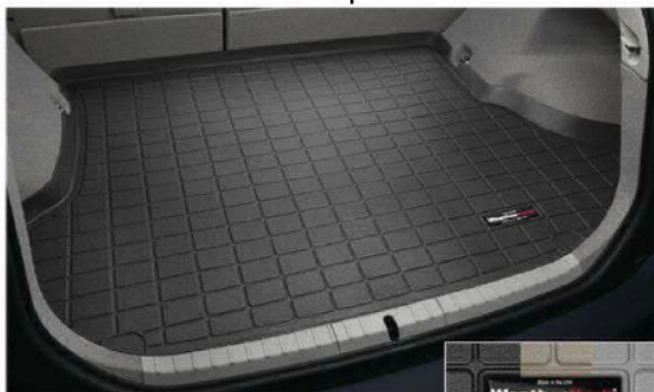
Available in Black, Tan and Grey for virtually any vehicle

Cargo/Trunk Liner

Complete trunk and cargo area protection

Digitally designed for each application

Remains flexible under temperature extremes



Available in Black, Tan and Grey for over 1000 applications



CargoTech™

Cargo containment system

Couples a durable plastic "fence" with a super-grippy underside to keep cargo stable

Excellent for cargo area organization

Works with WeatherTech® Cargo Liner or existing vehicle carpet or flooring

Accessories Available for

Acura · Audi · BMW · Buick · Cadillac · Chevrolet · Chrysler · Dodge · Ferrari · Ford · GMC · Honda · Hummer · Hyundai · Infiniti · Isuzu · Jeep · Kia · Land Rover · Lexus · Lincoln · Maserati · Mazda · Mercedes-Benz · Mercury · Mini · Mitsubishi · Nissan · Oldsmobile · Plymouth · Pontiac · Porsche · Saab · Saturn · Scion · Subaru · Suzuki · Toyota · Volkswagen · Volvo · and more!



TechLiner™

ARMOR YOUR INVESTMENT

Fits to the exact contours of each application

No messy sprays or drilling needed

100% recyclable, odorless material

Flexible and durable

Chemical and UV resistant



*TechLiner™ and
Tailgate shown*

Side Window Deflectors



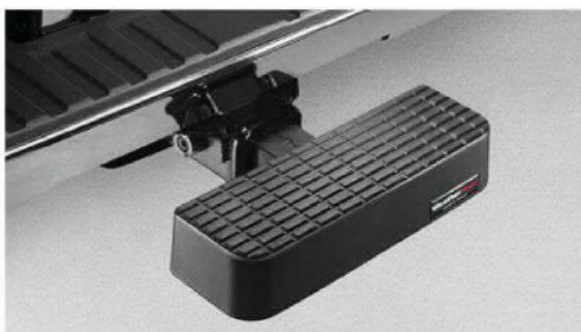
EASY TO INSTALL!

*No Exterior
Tape Needed*

Light and Dark Tint Available

Increases ventilation

Reduces wind noise and allows interior heat to escape



No-Drill Mudflaps



Mounts-In-Minutes™

Protect your vehicles most vulnerable rust area

Installs without tire/wheel removal

No drilling into the vehicle's fragile metal surface

Available for Trucks and SUVs

BumpStep™

Hitch mounted bumper protection

Protect your bumper from minor accidents

Fits standard 2" receiver hitch

Safely stand on the step (up to 300 lbs.)
for everyday tasks

Order Now: 800-441-6287



American Customers
WeatherTech.com



Canadian Customers
WeatherTech.ca



European Customers
WeatherTechEurope.com



THE RISE OF ARTISANAL ICE

And why you should care.

BY ANDREW DEL-COLLE

If you've been to an upscale bar or restaurant lately, you've probably noticed that bartenders are paying a lot more attention to ice, from the size and shape of the cube to the ingredients. The so-called artisanal-ice movement is in full swing. The name is a little stuffy, but it's easy to get behind anything that improves your cocktail. So, what exactly is the point of those chiseled cubes and tennis balls of ice? According to Charles Joly, beverage director at the ice-obsessed Aviary bar in Chicago, you want artisanal ice for two reasons: density and dilution.

"The way ice freezes in a typical freezer is basically from all directions, outside in," Joly says. Because of this, air and impurities get trapped inside the cube in the form

of flecks and bubbles. The clearer the ice, the denser it is. And the denser the ice, the more slowly it melts. The densest ice comes from nature, where constant water movement below the surface causes the freezing to happen top-down. That's why establishments that take their spirits seriously have been turning to natural-ice distributors. Some places, like Aviary, even make their own 200- to 300-pound blocks in machines that mimic the unidirectional freeze of the outdoors. These are the same machines used by ice sculptors, who need blocks dense enough to endure a chainsaw and then remain frozen for hours.

The vast majority of cocktails encounter ice at

some point during the drink-making process—whether they're getting shaken, stirred, or just chilled. Naturally, some of that ice melts, diluting the drink and altering the original balance. Planning for this dilution is important: "Take something like a mint julep," Joly says. "You really want that shaved, cracked, or crushed ice so it dilutes it and keeps it ice-cold, because you have that big ol' batch of whiskey in there." But a tumbler of scotch you want to slowly infuse with water and open up? That's when you reach for a giant cube. Dilution can also be used to impart new

flavors to a drink. Aviary, for instance, serves a margarita with cubes made from water mixed with the juice of Fresno chili peppers. As the ice melts, the drink becomes spicy instead of weak.

As for the hand-chiseling that happens behind the bar, Joly says that it's mostly to remind customers that the ice didn't come from one of the many molds widely available. Although it's not hard to find a bar that serves giant cubes these days, it doesn't mean the ice itself is anything special. The cloudy center gives it away. And not even a perfectly twirled mustache can make up for it.



HOW TO



MAKE DENSER ICE AT HOME

Ice made in plastic trays and silicone molds freezes from all sides, trapping impurities and making for a weaker cube.

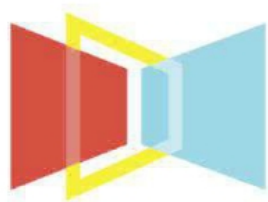
Using an open insulated cooler, which forces a top-down freeze, you can make your own dense, slow-melting ice. If you know

how to mix a proper drink, you'll taste the difference.

1. Fill a small, insulated cooler with

purified water.
2. Put cooler in freezer with top off.
3. Remove when ice is completely frozen.

4. Turn cooler upside down until the block slides out.
5. Let the ice rest to temper.
6. Chip away.



nextissue™

100+ MAGAZINES | ALL-YOU-CAN-READ ACCESS | ONE LOW PRICE

Try it
FREE for
30 days



START YOUR FREE TRIAL TODAY AT **NEXTISSUE.COM**



DJ Qbert's latest record jacket is interactive. And freaky-looking.



LEARN THE TERMS

Because every DJ needs to know them.

- **SCRATCHING:** A technique in which a vinyl record is pulled back and pushed forward on a turntable (*wickawicka*).
- **FADER:** A volume-control slider on a mixing board.
- **ONE-CLICK FLARE:** Close a fader (*click*) and cut a note in half.
- **ORBIT:** Click off the fader twice in succession, creating three notes.
- **CHIRP:** Scratch while at the same time opening and closing the fader; makes a bird-chirping sound.
- **CRAB:** Use four fingers to tap the fader and your thumb to close it after each tap.
- **SCRIBBLE:** Shake your arm as if it were vibrating; place a finger on the record.

TOUCH PAPER, MAKE MUSIC .

Revolutionary new technology lets you play DJ without a turntable.

BY JOE BARGMANN

Everyone, or at least some people, has wanted to be a DJ. Not a radio jock or a sweaty guy in a vest who spins vinyl at bar mitzvahs but a turntablist, wearing giant headphones and spinning records as a throng of beautiful people dance. A scratcher who puts the needle on the record and flicks it with his fingertips to make that cool *wickawicka* sound. Well, now you can be, kind of.

(Turntablist is a word, by the way.)

In the '80s and '90s the great DJs took two turntables connected by a mixing board and played them like a musical instrument, creating an aural montage of beats, guitar hooks, vocals, and other recorded samples, and added layers of scratching. A new invention called sonic paper removes the need for the hardware. It was created by electronics genius Kate Stone of Novalia, in Cambridge, England. Stone found a way to affix a programmable, Bluetooth-enabled chip to heavy paper stock. Using ink

that conducts electricity, Stone and her fellow artist-technologists print circuits onto the paper and program the chip so that each circuit creates a different sound. After the unit connects wirelessly to your iPhone or iPad, you touch the paper and sounds pour out of your device.

DJ Qbert, a renowned San Francisco DJ and onetime member of the influential Rock Steady Crew and the Invisibl Skratch Piklz, worked with Stone and Novalia to create an interactive unit—essentially a paper turntable—for his new album, *Extraterrestria/GalaXXXian*, out this fall. You touch the paper and it makes all the cool, scratchy DJ sounds you want, so you can scratch over Qbert's music like a real DJ—just by your finger coming into contact with the paper. It is astonishing.

"The paper is a controller," Qbert says. "You can actually do a party with that piece of paper." A strobe light, however, is not included.

Popular Mechanics

IN THE KNOW

THE ONE STOP SHOP FOR THOSE WHO KNOW IT. ALL.

**AMERICA'S ORIGINAL CRAFT VODKA**

In 1995, Tito Beveridge built America's original microdistillery in Austin, TX. Tito's Handmade Vodka has won numerous awards for its exceptional quality. Distilled 6 times from 100% corn. Made in USA Certified and gluten-free. Visit titosvodka.com for recipes and more.

Visit titosvodka.com for more information.

SECRET GOLD DEPOSIT FOUND!

The Stauer Midas Watch is a spectacular timepiece with a genuine Swiss movement and 24K gold face, available for the unbelievable price of only \$149 + S&P!

Call 1.888.201.7083 with promo code MIW153-01 or visit www.stauer.com for more information.

**BELT KITS AT ROCKAUTO.COM**

RockAuto carries belt drive component kits designed for specific cars and trucks that include a new belt plus the tensioners, idler pulleys and other parts needed to avoid surprises and ensure the repair is a long-term success.

Visit www.RockAuto.com for more information.

**DESIGN WITH FROGTAPE® SHAPE TAPE™**

Available in three on-trend, pre-cut patterns: wave, chevron and scallop, new FrogTape® Shape Tape™ makes it simple to achieve unique, decorative painting styles. Simply unroll, apply and get painting to create your desired look!

Call 1.877.FROGTAPE or visit www.FrogTape.com for more information.



INFRASTRUCTURE

THE BEHEMOTH

How five years, 964 piles, 14 miles of cable, and a few sturgeon come together to build a record-setting bridge. **BY DAVEY ALBA**

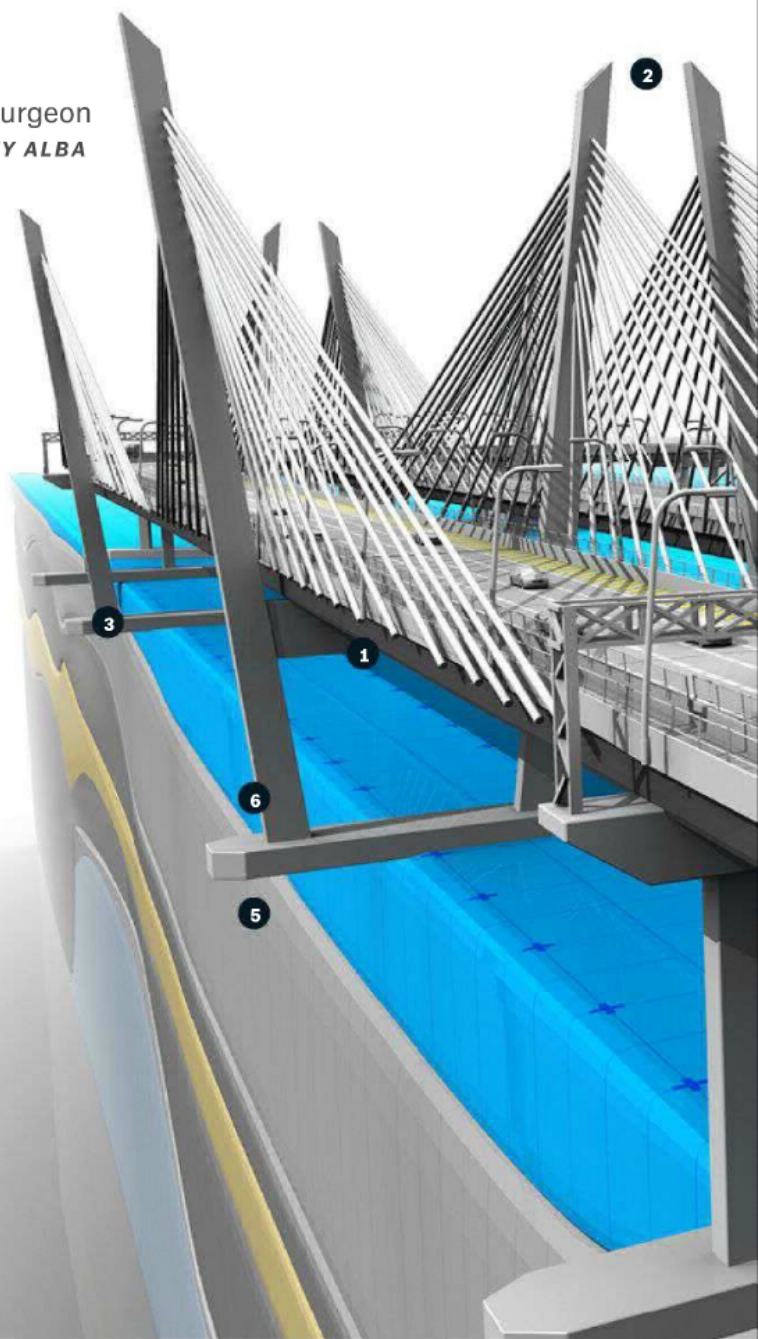
Twenty miles north of New York City, something loud and historic is happening. For the first time in a half-century New York is building a new bridge—a 3.1-mile, \$3.9 billion span over the Hudson River. And, this being New York, it's gotta be big. Real big. If you count the 40-foot gap for a possible future commuter rail between the spans (and we do), this will be one of the widest bridges in the world. It will be an accomplishment and a centerpiece—and, best of all, it won't need major repairs for at least 100 years.

The same can't be said of the current bridge, the Tappan Zee. It was lucky to make it this far. Every day 138,000 vehicles drive over it, even though it was meant to handle a maximum of 100,000. Cobbled together on the cheap during a period of material shortages after the Korean War, the existing crossing was built for a 50-year life span. Almost 10 years beyond that, the Federal Highway Administration considers it a "fracture-critical" bridge. Workers had been shoring up the creaky structure since 2007, reinforcing rusting steel supports and patching the crumbling concrete. If the state had decided to keep the bridge, it would have had to spend \$3 billion to \$4 billion over the next 20 years for maintenance, on top of the \$750 million spent on past renovations. The new bridge can't be finished soon enough.

1. The bridge will be made up of two parallel spans with a 40-foot gap for a possible commuter rail—for a combined breadth of 223 feet. When both spans are finished, in 2018, each will have four traffic lanes, two break-down lanes, and a lane for emergency vehicles and express buses. The luxurious northern span will even have a path to accommodate cyclists and pedestrians.

2. The design of the towers is such that, if the rail line is eventually added between the spans, the towers could be joined at the top to form a pyramid in order to support the additional weight.

3. To buttress the new bridge, crews on barges use enormous, vibrating hammers to drive 964 steel piles—giant, hollow tubes 4 to 6 feet in diameter and up to 360 feet long—into the bottom of the Hudson. The piles on the eastern side of the river are buried 200 to 250 feet deep, through silt and into bedrock. The bedrock on the west side of the river, however, is an unreachable 700 feet below the surface of the water, forcing crews to sink the piles another 100 feet into the riverbed for stability.



AND THE ENORMOUS CRANE THAT HELPED BUILD IT



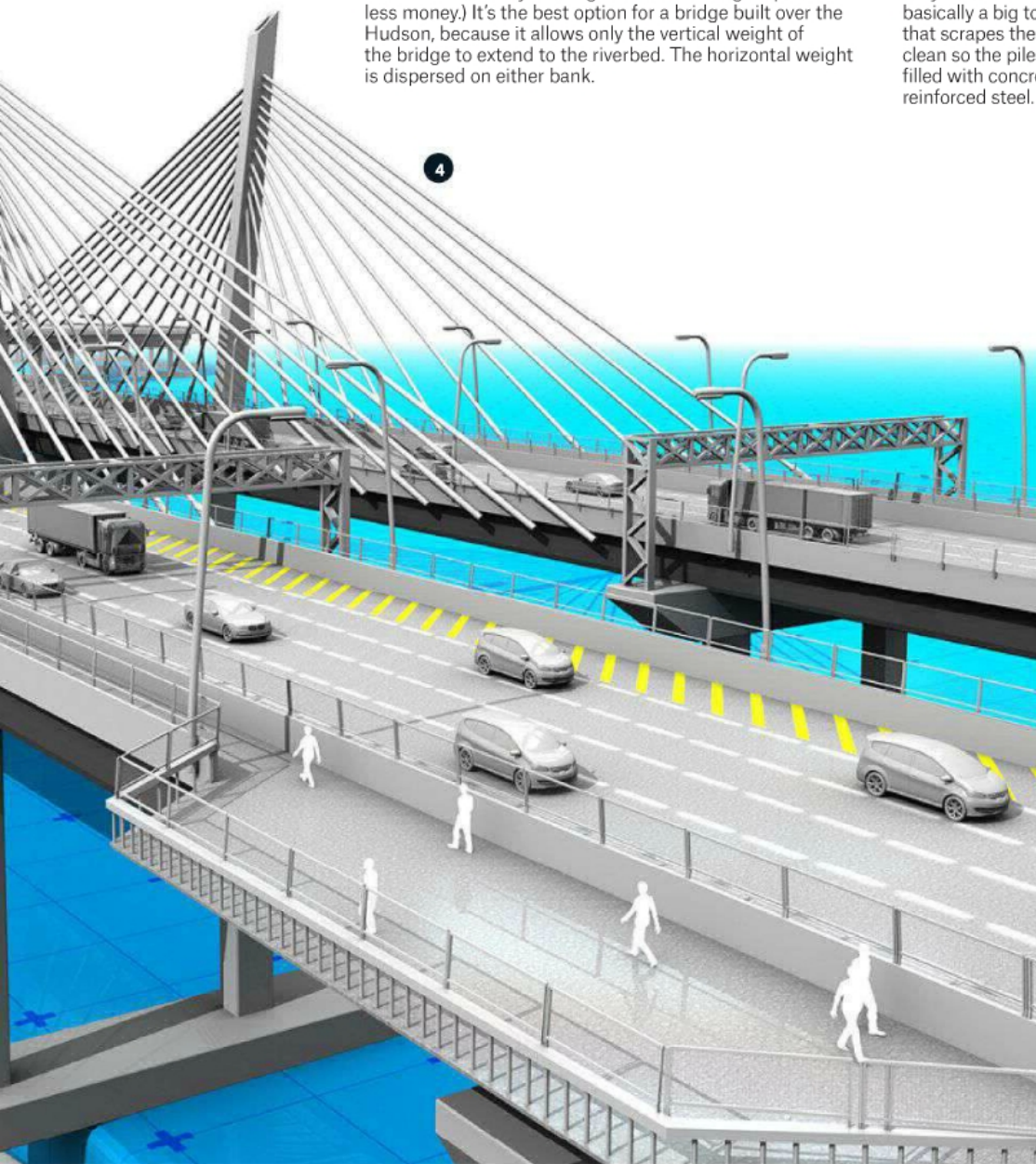
Last winter construction crews called in backup: the Left Coast Lifter, a towering crane that got its name after helping repair the earthquake-mangled eastern span of the San Francisco-Oakland Bay Bridge in 2009.



4. To support a thicker, sturdier road deck, the bridge will be cable-stayed; in this case, the weight of the bridge is held up by cables anchored to four towers, each rising 419 feet above the surface of the road. (The once-favored suspension bridge recently gave way to cable-stayed, because cable-stayed bridges can cover longer spans for less money.) It's the best option for a bridge built over the Hudson, because it allows only the vertical weight of the bridge to extend to the riverbed. The horizontal weight is dispersed on either bank.

5. The silt and water that fill each hollow pile as it is plunged into the riverbed are removed by a tool designed specifically for the new bridge—basically a big toothbrush that scrapes the walls clean so the piles can be filled with concrete and reinforced steel.

6. Each tower will be built on clusters of 60 pipes but not before they are tested: An empty barge is placed on top of the pile, then filled with water to create a load of 7 million pounds—more than enough to stand up to a day's traffic.



4



THE PILE DRIVER

Banging 90-ton piles into bedrock gets noisy, which is bad for two reasons. The first is the neighbors: The state and its contractor are spending \$4.2 million to install sound-dampening windows and doors on nearby condo units and homes. Then there are the fish: Resulting sound waves disturb a fish's swim bladder, the gas-filled organ that helps control buoyancy, which could lead to hemorrhaging and death. To limit the effects on the two endangered species that thrive in the Hudson—Atlantic and shortnose sturgeon—every steel pile is wrapped in a "bubble curtain" as it's being pounded in. This aluminum ring slides over the piling like a doughnut on a baseball bat, pumping out air and forming a sleeve of froth that absorbs 10 decibels of sound.

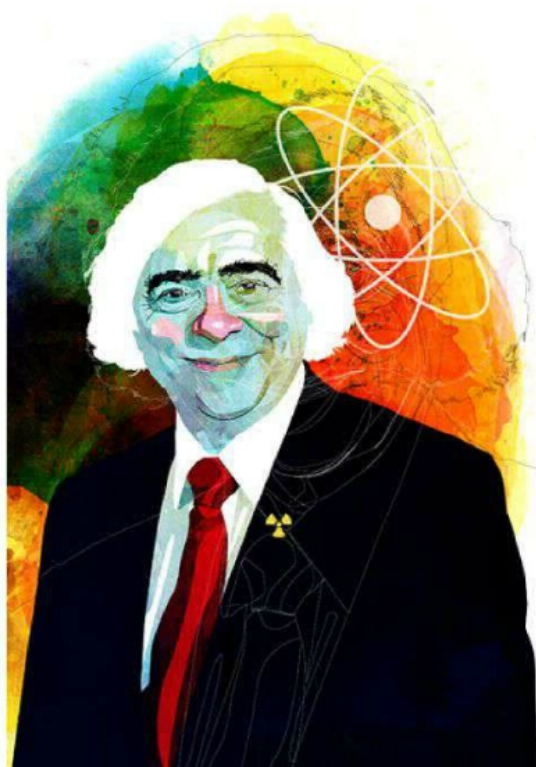


Perched atop a barge longer than a football field, the Lifter sailed 6,000 miles from California, through the Panama Canal and up the East Coast, chaperoned by tugboats. It's one of the largest

floating cranes in the world.

With a boom height of 328 feet, arm length of 25 stories, and lift capacity of 1,900 tons (the equivalent of 12 Statues of Liberty), the Lifter will heave large steel girders and prefabricated

sections of the road deck into place and help tear down the old Tappan Zee. Using it will shorten the construction schedule by months and help trim production costs by \$800 million.



OBAMA'S ENERGY GURU

Secretary of Energy Ernest Moniz on America's nuclear future, fossil fuels, and electricity shaming.

INTERVIEWED BY MATT BUCHANAN

POPULAR MECHANICS: The United States has 100 nuclear reactors in 62 plants, supplying over 19 percent of our electricity. Several more plants are scheduled to start operating within the next decade. How does nuclear fit within President Obama's "all-of-the-above" energy strategy?

Ernest Moniz: We see every fuel and technology and efficiency as having a place in a low-carbon marketplace. As far as nuclear goes, I believe there are two issues. One will be the cost and scheduled performance of the new reactors being built in Georgia and South Carolina. Second will be, on a slightly longer time scale—let's say early in

the next decade—the cost-performance of the first small, modular reactors that we anticipate having online by 2022 or 2023. Those are very, very critical issues. You might note that I mention cost in both cases. Capital cost for nuclear is high, operating cost is low.

PM: What are the benefits of modular reactors?

EM: We've seen a couple of reactors—huge 1,400-megawatt reactors—being built in Europe today, where they have a construction issue, and that gets pretty expensive to take care of. With a small, modular reactor, if the market is big enough, you'll have a controlled manufacturing environment that's better for quality control.

PM: If it's more economical, would you expect the mix of nuclear power in America's energy portfolio to increase?

EM: If small, modular reactors look attractive, I could certainly imagine that. I can also add, which is important for the manufacturing argument I made, that everywhere I go internationally there is tremendous interest in smaller reactors.

PM: When the EPA announced the proposed rule to reduce CO₂ emissions 30 percent below 2005 levels by 2030, there was some opposition. How do you balance what you see as the reality of the situation with the politics?

EM: If we're talking about reducing carbon emissions in the power sector by an additional 30 percent by 2030, or 80 percent by 2050, that's obviously a substantial transformation. If we focus on the electricity system—it's... let's call it 70 percent fossil fuels. The coal users are concerned—but the decrease in coal use over the last five to six years, I want to emphasize, has been a marketplace response to the low natural-gas prices. What we say is, look, we're putting a

lot of money on the table: \$6 billion dollars for large-scale demonstrations of carbon capture, utilization, and storage from coal plants and industrial facilities. We also have a call out for \$8 billion in loan guarantees for any fossil technology that will push the envelope and lower CO₂ emissions. "All of the

"Coal users are concerned—but the decrease in coal use has been a marketplace response to low natural-gas prices."

above" means we're not giving up on any source.

PM: Natural gas is cheap right now. We have an established fossil-fuel infrastructure. Is there less motivation to invest in clean, renewable energies?

EM: This concern has been expressed many times. We are continuing to see robust deployment of wind and solar. Coming into this year, I think solar has a total deployment in the United States of 13,000 megawatts. Wind has been a little up and down with the instability of the Production Tax Credit, but even recently—in 2012, I believe—it was the largest capacity addition or maybe just behind gas but very, very close.

PM: The Department of Energy has been aggressive about new standards for appliance efficiency with the Environmental Protection Agency's Energy Star program. But how do we make consumers take more personal responsibility?

EM: There are informational and behavioral approaches. For example, my real home is in Boston, and whether it's electricity or gas, I get a monthly indicator as to how much I use relative to my neighbors. So there's either a little embarrassment or competition there.

PM: How effective has the Energy Star program been?

EM: Between now and 2030 we're talking almost a half a trillion dollars of consumer-energy cost savings and roughly 3 billion tons of CO₂ avoided. So you just gotta keep at it.

That work?

PM: Yep, thank you very much.



\$1 SILVER EAGLE
1 oz Silver
Limit 20



\$5 GOLD EAGLE
1/10 oz Gold
Limit 5

Introducing

the new

2014 American Eagles

(coins enlarged to show exquisite detail)

Starting today, telephone orders will be accepted on a first-come, first-served basis. Special price valid for 30 days only or while supplies last.

American Eagle Gold and Silver Bullion Coins are America's only official investment-grade gold and silver bullion coins. They're also the world's only gold and silver bullion coins whose weight, content, and purity are guaranteed by the United States Government. So like the dollar, American Eagles are welcome in major investment markets worldwide. You can even include them in Individual Retirement Accounts (IRA's). Many investment experts believe that adding precious metals, such as gold and silver, to your portfolio may improve its performance and reduce your portfolio's volatility. Easily converted into cash, American Eagle Bullion Coins can be sold for cash at most coin and precious metal dealers worldwide.

only **\$1.⁰⁰** *Over Dealer Cost*

CALL NOW TO ORDER
1-877-227-COIN

(877) 227-2646

Vault Code: PMGSE - 0814

Mastercard • Visa • Amex • Discover



Texas

www.Aerloms.com

Dealer cost at time of transaction, including merchant fees for credit card purchases. Coins shown are not actual size. Limit 5 gold coins and 20 silver coins per household. Price plus shipping. No sales tax on gold and silver purchases. Prices subject to change without notice. Availability not guaranteed. New customers only. No dealers please. American Eagle Reserve is not affiliated with the U.S. Government.

TECH

THE FUTURE GETS PRETTY

The greatest advancement in photography finally earns an outside worthy of its inside.

BY PETER MARTIN



By capturing light from every angle, the new Lytro Illum lets you choose new focal points after taking the picture.

Lytro is the most exciting thing to happen to cameras since Maria Sharapova shot her first Canon commercial. Instead of forcing you to pick an aperture (the setting that determines how much light reaches the camera sensor, and therefore how many levels of an image can be in focus), Lytro cameras capture light from all angles. This means you can focus a picture *after* you take it. And then you can focus it again somewhere else, as many times as you want, on any point that you please.

The first iteration, which came out in early 2012, looked and functioned like a kid's toy—a tube with a grainy,

1.5-inch display and finicky digital zoom. But this summer, Lytro introduced the Illum (\$1,499), a camera you wouldn't be embarrassed to be seen with on vacation, with a 4-inch LCD screen, 8x optical zoom, and something Lytro calls a 40-megaray sensor.

If you're wondering what a megaray is, you're in good company: The rest of us don't know, either. Honestly, neither does Lytro. Not that it needs to, since when you define the terms, you define the scale. What should matter to you is what the Illum can do—and what it means for cameras in the future. This is a camera that doesn't need lenses. It doesn't need you to think. It takes care of the

thinking for you.

Yes, the Illum is expensive. Yes, if you zoom out, you lose a lot of the forced perspective, and thus the benefits of the technology. And yes, the files are so big (50 megabytes each) that photos take 3 to 6 seconds just to pull up on the viewfinder. But the Illum is an important second step, both for Lytro and for the rest of us. It takes out the guesswork. If you capture every angle, you capture the right angle. No fiddling with settings, no tweaking the focus until you have just the right shot. It makes us pay more attention to the image than the technique. And it makes us photographers. Even if we don't know what we're doing.



IF YOU'D RATHER SPEND A MORTGAGE PAYMENT ON A MORE TRADITIONAL CAMERA

For the first time ever, this spring Leica introduced a camera that doesn't hew entirely to its past, at least not for aesthetic cues. Designed with Audi, the 16.5-megapixel, mirrorless T (\$1,850) is the first camera in the world to be milled from a single block of aluminum, which makes it sturdy and beautiful in equal measure. Same unsurpassed optics (and, with an adapter, you can still use your old lenses) but in a completely rethought frame. You'll be the envy of the photography club—and anyone else who happens to see your new camera.



THE IDEAL TAILGATE

Everything you need besides the win.

BY ANDREW DEL-COLLE

1. LOGITECH UE BOOM PORTABLE BLUETOOTH SPEAKER \$200
Omnidirectional. Loud.

2. DISH NETWORK TAILGATER ANTENNA AND RECEIVER \$500
So much better than rabbit ears, with no annual contract.

3. INTOCIRCUIT 11,200-MAH POWER CASTLE CHARGER \$40
Lightweight, superfast. Can charge two devices at once.

4. BLUE RIDGE CHAIR WORKS BLUE RIDGE CHAIR \$95
Packs flat, actually comfortable, holds up to 300 pounds of fan.

5. WEBER JUMBO JOE CHARCOAL GRILL \$60
A squatty version of the classic, with just-as-big cooking surface.

6. GENERAC IX SERIES 1,600-WATT GAS GENERATOR \$479
Inexpensive and surprisingly quiet. And unlike your car battery, it will actually power the TV.

7. HANDSOME DAN LEATHER HEAD FOOTBALL \$130
Smaller than a regulation ball, thus easier to throw, and hand-stitched, thus beautiful.

8. FARIBAUT FOOT SOLDIER MILITARY BLANKET, \$215
Durable, 100% wool that'll keep you warm through the playoffs. Best of all, it's machine washable.

9. SAMSUNG H6350 TV, \$550
At 32", small enough to fit in the trunk and big enough to actually see, with bright LED backlighting and a 120-Hz refresh rate that won't blur with the action.



TRY THIS:

BEN FORD'S NOT-SO-SECRET BURGER SAUCE

Chef and restaurateur Ben Ford knows the kitchen, but he prefers serving large crowds outside. Here's his recipe for a classic burger spread. For more, check out *Taming the Feast: Ben Ford's Field Guide to Adventurous Cooking* (Atria Books, 2014).

INGREDIENTS:

- 1 cup mayonnaise
- ¼ cup ketchup
- 2 Tbsp red- or white-wine vinegar
- 1 Tbsp sweet-pickle relish
- 1 tsp Worcestershire sauce
- 1 tsp freshly ground black pepper
- ½ tsp kosher salt

- ⅓ tsp garlic powder
- ⅓ tsp onion powder

INSTRUCTIONS:

1. Stir all the ingredients together in a bowl.
2. Sample the sauce and tweak it to taste.
3. Refrigerate until game time.



ANCIENT SECRETS REVEALED!

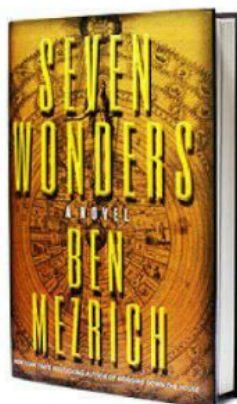
A murder, an archaeologist, and the seven wonders of the world—here's your summer reading. **BY RACHEL Z. ARNDT**

We are drawn to conspiracy theories because we're drawn to explanations—the cause and effect that brings us, even temporarily, certainty and order. Ben Mezrich knows this. He also knows the power of the chase—the perilous trails hewn by risk-embracing adventurers. His previous books include nonfiction thrillers that have been made into big movies—*The Accidental Billionaires*

became the 2010 Oscar-winning movie *The Social Network*, and *Bringing Down the House* became *21*, starring Kevin Spacey. In *Seven Wonders*, his first novel, he gives us slick archaeologist Jack Grady, hot botanist (and possible love interest) Sloane Costa, and conniving billionaire Jendari Saphra, all of them on a quest for the unknown: the Garden of Eden.

To get there Mezrich's

characters jet around the globe, making stops at each of the seven wonders of the modern world (the Colosseum, the Great Wall of China, Machu Picchu, and the other four). They're after that garden, and they're also after the answer to the question: Why did a shadowy figure kill Jack Grady's twin brother, Jeremy? (This happens in the first nine pages—I'm not spoiling anything.) Jack, driven to



avenge his brother's death, sets out, archaeologist-style, on an expedition to each of the seven wonders to uncover the secret Jeremy knew that was so threatening he had to die before he could share it.

The story that unfolds is one of dualities: Jeremy and Jack, two very different brothers. The two sets of the seven wonders, ancient and modern. The double helices of a strand of DNA. Such a setup, with its interweavings and its characters who dance around one another but rarely meet, creates a tension that makes for thrilling reading. We follow Jack and his fellow academic Sloane around the world, and we follow heiress Jendari and her minions as they follow them. Mezrich was smart to keep the sets of characters separate for much of the book. The question, as the pairs descend on one another, becomes not will they make it but who will get there first.

Mezrich spruces up the search with specifics, giving us—and his characters—data to hold on to. The quantifiable never escapes our narrator, who informs us, for example, about the structure of the Taj Mahal—the number of minarets, their height, the fact that “the weight of the construct itself [keeps] it together,” a nice metaphor for conspiracies in general. And there are the details of the visit to each wonder, which involve dodging ivory spears, blowing up a plane near the *Christ the Redeemer* statue in Rio de Janeiro, and other razor-thin escapes.

Mezrich has already sold the rights to *Seven Wonders* to 20th Century Fox. If all goes as planned, this will be the first in a trilogy of Jack Grady adventures—none of which, we hope, involves Nicolas Cage.

CARTOONIST OF THE MONTH

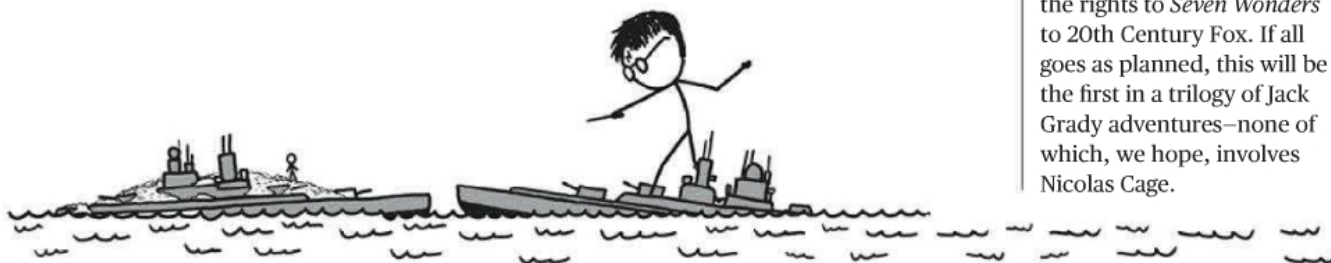


Randall Munroe is a NASA roboticist turned Web cartoonist with a cult following and a website, XKCD.com, that draws millions of people each week. And now he has a book. *What If?: Serious Scientific Answers to Absurd Hypothetical Questions* is a collection of his trademark doodles and clever responses to insanely complex scientific scenarios thrown at him by his fans. We asked him a question of our own:

Q: How many issues of **POPULAR MECHANICS** would it take to sink a battleship?

RM: About 1.29 million copies of each issue of **POPULAR MECHANICS** are printed. At an average weight of 5.12 ounces each, that's a total of 187 tons per issue (roughly, one blue whale). This would be enough to sink a medium-size tugboat, but a large battleship can carry over 50 times that much weight. To sink it, you would need to collect nearly a decade's worth of issues.

Fortunately, there's a faster alternative. On the day it was released, J. K. Rowling's *Harry Potter and the Deathly Hallows* sold about 9 million copies. That's more than 250 pounds of books per second. In 24 hours over 10,000 tons of the books were sold. It's like the old saying goes: Magazines are heavy, but if you want to sink a battleship fast, you need a wizard. At least, I think that's the old saying.



A Better Bed = Better Sleep



Reverie® Sleep Systems include a mattress customized for you and an adjustable foundation that allows you to experience total comfort.

Support Customized for Each of You

- DreamCells,™ Reverie's patented support system, allow customized firmness levels on each side of the mattress so both of you are most comfortable.

Adjustable Foundation for Sleeping and Relaxation

- Elevate or lower each side of the bed independently (with Split King sized models) to suit your sleeping preference.
- Anti-Snore setting: May help those who snore or have acid reflux.
- Zero-Gravity setting: Soothing for those with back pain.
- Control the foundation with the remote or with your tablet or smart phone.
- Relax and fall asleep more easily with the full body massage feature.

Natural Materials for a Healthy Sleep Environment

- Constructed with natural, breathable materials for healthy, comfortable sleep.
- Naturally anti-bacterial, anti-microbial and dust mite resistant.



DreamCells,™ Reverie's unique support system, come in four different firmness levels as illustrated by these weights.

Get a FREE Info Kit

Learn how this revolutionary new Sleep System can improve your sleep.

Call 1-800-685-3445

www.reverie.com

Reverie®
Sleep well tonight. Live better tomorrow.™

©2014 Reverie. All rights reserved.
750 Denison Ct., Bloomfield Hills, MI 48302
Dept. 1073

AEROBATICS



The Extra 300L can reach 253 mph and is FAA-approved to withstand 10 g's of force.



HOW STUNT PLANES FLY

A day with a stunt pilot revealed the limits of what a plane—and a person—can withstand. **BY JOSHUA A. KRISCH**

The cherry-red stunt plane tore off the runway as the tree line blurred beneath us. My life—and the location of my lunch—was entirely in the hands of Jeff Boerboon, the 2010 U.S. National Aerobatic Champion, who sat at the controls. It was practice day at the Bethpage Airshow in New York, and we were strapped into the cockpit of his two-passenger Extra 300L—an aerobatic aircraft that can reach speeds of 253 mph. Boerboon asked if I was ready, then, before I could respond, yanked the stick to one side. Here are some of the stunts we tried that nearly killed me.

LOOP

What it is: Vertical loop at 180 mph.

How it works: We were pulling close to 4 g's at the top of the loop, which would have put serious strain on a lesser plane's structure (a 747 could break under similar stress). But the Extra is reinforced with steel tubes and carbon fiber, so its frame can easily handle up to 10 g's.

How it feels: The climb jammed me into the seat. Suddenly, the sky was down, the sea was up, and g-forces were crushing my chest. I may have screamed into my headset.

AILERON ROLL

What it is: A tight roll around the horizontal axis.

How it works: Airplanes stay up because of "lift," the difference between airflow above and below the wings. A regular plane would drop like a rock if it inverted. But the Extra's wings are symmetrical. When the plane does a knife-edge (wings vertical), the rudder—a movable fin on the tail—acts like a small, sideways wing.

How it feels: It took only a light tap of the Extra's stick to flip us. One roll wasn't so bad. A series of them gave me sickening vertigo.



In a vertical spin, the plane moves in a spiraling, downward corkscrew. It feels like plunging to your death in slow motion.



VERTICAL SPIN

What it is: Straight up until you nearly stall, before spinning back toward the earth.

How it works: A standard airplane has precise control surfaces, such as the horizontal stabilizers on its tail. Executing a spin demands instability, however, so the Extra has an oversize rudder and elevators so pilots can get into and out of spins.

How it feels: Spins are sluggish maneuvers—the power is at idle, and you're falling at a fairly constant speed. I was acutely aware of how little Boerboon was doing to manipulate the plane.

HAMMERHEAD TURN

What it is: A climb with a cartwheel turn at the peak.

How it works: Rockets can lift off because their thrust is greater than their weight. The thrust-to-weight ratio in a Boeing 757 is only 0.33, but the Extra 300L boasts a higher ratio, 0.55. That means the stunt plane can accelerate rapidly and has a high climb rate.

How it feels: The same formidable g-forces as the loop, but at the top you get a gut-churning wing-over-wing spin. My teeth are still clenched from the ride.

Drive Smarter This Summer

Take Ticket Protection to the Max

The World's Best Detector

PASSPORT Max

Get the radar detector with the fastest response and most accuracy



\$549.⁹⁵

Take PASSPORT Max on a 30 day worry-free test drive today.

The World's Best Network

ESCORT Live

Join the network responsible for over 17 million saves*



Connect To
**ESCORT.
((Live!))**

Optional



AutoLearn technology
uses GPS to reject
false alarms



DEFENDER™ Database
alerts you to
camera speed traps



Brilliant graphics*
identify the threat
at a glance



Plug in optional
SmartCord Live to connect
to iPhone or Android



View your speed,
speed limit and
radar sensitivity



Locate threats
on your route
in real time

ESCORT.
DRIVE SMARTER.



800.852.6258 EscortRadar.com [Facebook.com/DriveSmarter](https://www.facebook.com/DriveSmarter)

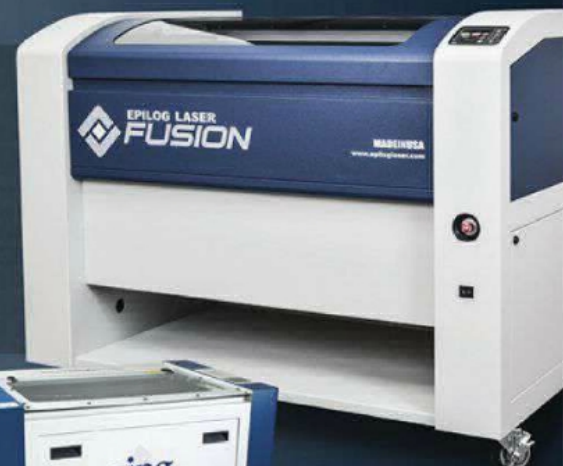
The ESCORT Store • 5440 West Chester Road • West Chester OH 45069

Department PMECH ©2014 ESCORT Inc. *Shown with ESCORT Live, requires optional cord and subscription. MI and OH residents add tax.



ENGRAVE IT. CUT IT. MARK IT.

Laser cut and engrave even the most elaborate designs with ease.



Desktop Systems Starting at \$7,995

From cutting and stacking 3D models, to engraving photos on electronics, to marking logos on parts and accessories, our laser systems engrave and cut the products you see here and much more!

Contact Epilog Laser today for a laser system demo!

epiloglaser.com/popmech • sales@epiloglaser.com • 888-437-4564

MADEiNUSA
Golden, Colorado

WOOD

THE RECOVERY WILL BE BUILT WITH 2x4s

With so much high-quality, old-growth lumber in Detroit's blighted houses, the best way to help the city is by tearing it apart. **BY MATT GOULET**

Even when you're flying around the freeways that encircle the desolate city, you can see them: shadows of homes looming vacant along the same arteries Detroit's former residents used to exit the place. You head into the actual neighborhoods, and there's maybe one occupied house on any given block—the rest fester in abandonment. Blight has crept over the landscape in the 60 years it has taken the city's population to dwindle from 1.8 million to less than 700,000.

When Detroit was booming—from the

1920s through the 1950s—these structures were middle-class dream homes for the new Americans working the city's factories. They were built as tough as the people themselves, framed out with old-growth Michigan forests. Oak with growth rings that count back to the 300 years before it was cut. Douglas fir rough-sawed into true-to-measure 2 x 4s—2 full inches by 4. Brilliant red gum used for mere joists. Dense southern yellow pine. All of it superior to, and sturdier and more beautiful than, any wood used in construction in the past 30 years.

An estimated 240 million board

feet of the old lumber still props up the 78,506 dilapidated and abandoned homes that a task force has marked for teardown. All of that wood, if it's in good enough condition, can sell for the same price—around \$2 per foot—as new oak, cherry, and maple. And with reclaimed wood having a moment, 240 million board feet can make a lot of countertops.

Two nonprofit groups, Architectural Salvage Warehouse of Detroit and Reclaim Detroit, are undertaking a massive urban-excavation project, deconstructing the run-down structures into the pieces they were built

Some 240 million board feet of reclaimable wood sits like buried treasure in the city's blighted homes.



PHOTOGRAPH BY RECLAIM DETROIT



WORK WITH RECLAIMED WOOD

Because salvaged wood's best qualities can be its most infuriating.

One end of your 2 x 4 could be wider than the other. Or the board is warped. Or a portion could be water-damaged. You won't be able to use every inch of a piece of lumber in a project, so purchase a little too much material to work with.

It takes one rogue nail to wreak havoc on a saw blade. Good salvage warehouses will have removed most metal from the lumber, but anything that's still embedded needs to be cut around.

Lightly sand the entire board, using heavier-grit (80- to 100-) sandpaper to remove splinters but keep the patina.

When cutting and assembling, remember that the interesting part of the wood is the outside surface and the end grain. The interior surface grain of an old 2 x 4 looks about the same as a new one's.

Assume any paint on a piece of reclaimed wood is lead-based, which is safe for no one. Cut off and discard the painted area or coat the finished product in a highly durable polyurethane so the paint is behind a protective barrier.

A wax finish will mildly protect while keeping an untreated appearance. Polyurethane gives a shine and durability to high-use furniture. Apply clear coats or satin finishes like you would on regular wood but don't use stains. You want the natural qualities to show through.

With thanks to Chris Behm, cofounder of End Grain Woodworking, Detroit.

from. Deconstruction is doing construction work backward, reclaiming any materials that can be returned to the marketplace in the process. They take their crews—usually unemployed workers, former felons, or unskilled laborers who get training and work as part of the workforce-development programs—into the sagging homes and systematically piece the place apart. Reclaim Detroit alone has already trained more than 300 people since it was started in 2011.

It's expensive. Deconstruction of a single house requires a skilled team of five to six men and about three days, while a straight demolition is two guys and an afternoon. But in a city where unemployment hovers around 15 percent, it doesn't hurt to put extra people to work. And the money from the sale of the reclaimed lumber pays for the training and wages of more workers. The organizations have made their case so well that Mayor Mike Duggan has declared deconstruction an institutional-

ized part of the blight-removal effort.

So, among century-old Polish immigration papers and yellowed birth certificates tucked into long-forgotten corners, from behind graffitied walls in the abandoned kitchens where the American dream played out two or three times over, the crews pull out the lumber. Architectural Salvage Warehouse stamps the original address on each piece of wood extracted, more an act of remembrance than organization. They and Reclaim Detroit have shipped lumber to New York and California. They've taken orders from Tokyo, installed reclaimed wood in a LEED-certified McDonald's, and sold pieces to individuals and designers who value the wood for its air-dried patina and old-growth grain.

But the wood is best on display in Detroit itself. Inside new coffee shops, restaurants, and startup offices in the awakening parts of the city, reclaimed lumber is showing up as tables and walls. The old Detroit is propping up the new.

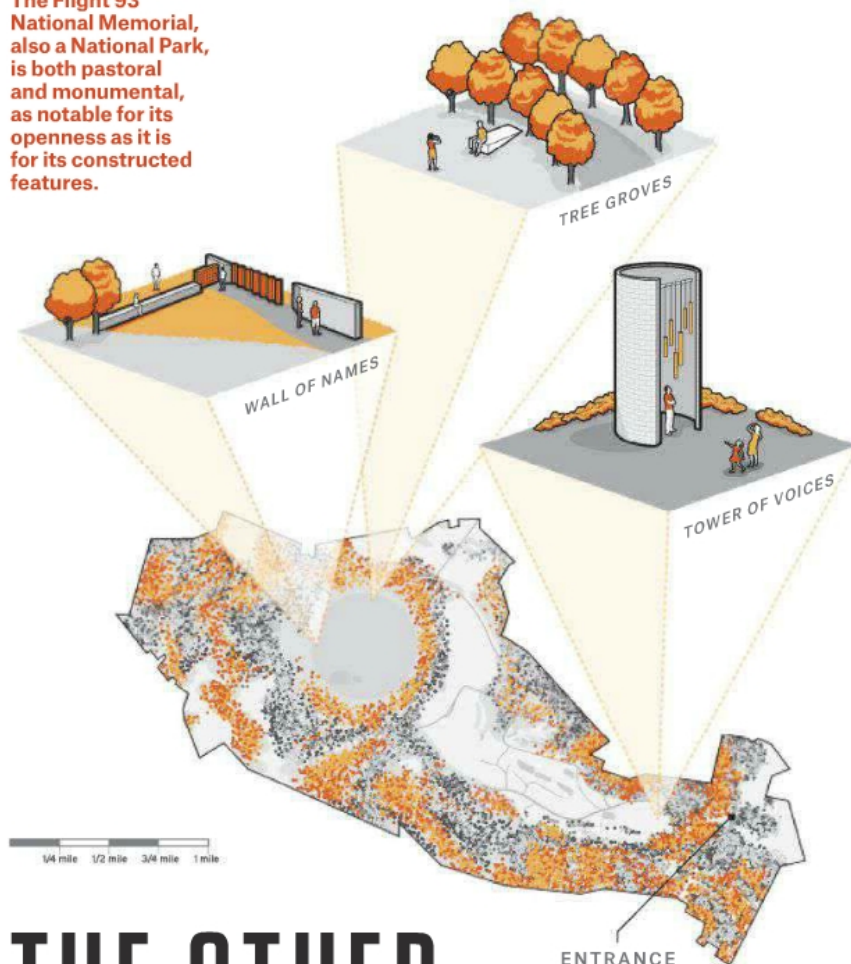
The sales of Reclaim Detroit's end-grain cutting boards (\$109, reclaimdetroit.org) go toward training and paying new workers.



ILLUSTRATION BY BROWN BIRD DESIGN

EARTH

The Flight 93 National Memorial, also a National Park, is both pastoral and monumental, as notable for its openness as it is for its constructed features.



THE OTHER 9/11 MEMORIAL

In rural Pennsylvania, 300 miles from the new 9/11 Museum, a very different memorial is taking shape. **BY JOE BARGMANN**

This is the thirteenth September since 9/11. Earlier this year, deep beneath the ground where the World Trade Center towers once stood, a museum chronicling the events of that day opened to great fanfare, mixed reviews, and long lines. It cost more than \$700 million to build. Admission for one is \$24. There's a gift shop.

Out in western Pennsylvania, in a field 75 miles southeast of Pittsburgh, another memorial is under construction,

just as important and on its way to being astonishingly beautiful. It is the Flight 93 National Memorial, commemorating the 40 passengers and crew who gave their lives there so that others might be saved. But this memorial is strangely unpublishized, the full \$70 million to complete it hasn't been raised, and it's not due to be finished for another two years. The delay is a national disgrace.

Part of the problem is the site itself. It sprawls over 1,200 acres—and may grow to 2,200 acres—while the memo-

rials in New York and at the Pentagon are contained on 8- and 2-acre plots, respectively. Ground Zero required years of clearing and preparation, but the obstacles were plain to see. The field near Shanksville, Pennsylvania, on the other hand, held surprises. Much of the land was once an open-pit coal mine, and the environmental damage required painstaking surveying, sampling, and storm-water management to contain acid mine drainage. A reclaimed wetland was enlarged to present a restored habitat to visitors. Site prep and land acquisition ate up a decade.

Finally, this past spring, the second of three major construction phases began. It includes an 800-foot pedestrian bridge over the wetland, a visitors center, and a 9/11 learning facility. These join two other important pieces already in place: a long, black-granite walkway that traces the path of the plummeting plane and a zigzagging white-marble wall engraved with the victims' names. Eventually, 40 groves of trees, one for each passenger and crew member, will surround the central feature: a 400-acre bowl that was regraded and seeded with native grasses and wildflowers.

The most prominent element of the memorial will be a 93-foot-tall concrete sculpture with 40 chimes, the Tower of Voices. Paul Murdoch, the Los Angeles-based architect who is designing the memorial, says the tower expresses a vital part of the United Airlines Flight 93 narrative: After the passengers learned that the plane was part of a terrorist attack, they resolved to force it down, and their phone calls home became a brave but desperate chorus. *I love you. Kiss the kids for me. Goodbye.*

As of July the \$1.5 million for the tower had not been secured.

Murdoch says the tower, like the wall of names and the black path, is designed to elicit a visceral reaction. "Our intent was to create some very focused moments in that large landscape," he says. "We want visitors to move through the memorial, experience these moments, and then move along and process them."

And so Murdoch is leaving much of the site untouched, as quiet and peaceful as it was before the impact that transformed it forever.



✓Yes



✓Yes



xNo



✓Yes



✓Yes



✓Yes

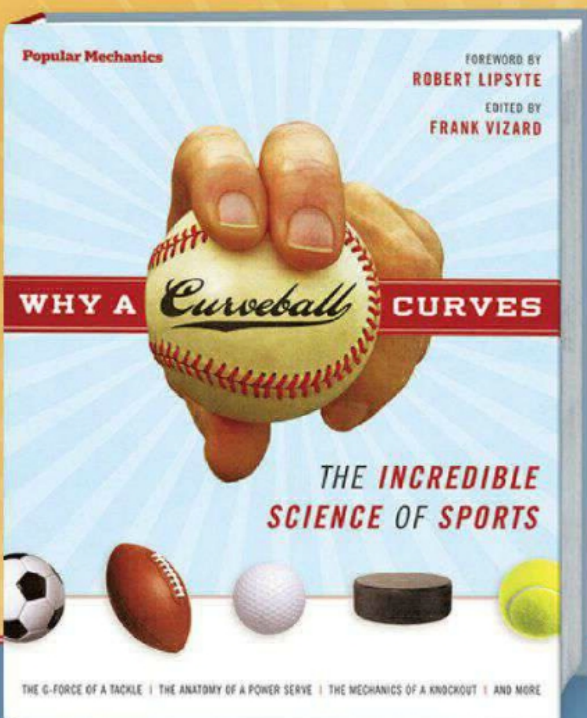


✓Yes



✓Yes

✓ Reliably Low Prices
 ✓ Easy To Use Website
 ✓ Huge Selection
 ✓ Fast Shipping
www.rockauto.com



WE'VE GOT SPORTS DOWN TO A SCIENCE

From the G-force of a tackle to the anatomy of a power serve, from the physics of Beckham's kick to the mechanics of Tiger's swing—everything you've ever wanted to know is right here.

FIND OUT THE SCIENCE OF

- Baseball
- Cycling
- Golf
- Skiing
- Basketball
- Diving
- Hockey
- Soccer
- Boxing
- Football
- Running
- Tennis

Available wherever books are sold.

HEARST BOOKS

GREAT UNKNOWNNS



YOU HAVE QUESTIONS. Everyone does. Questions about the world—great, important questions, or questions that are inconsequential but just kind of interesting—that fly through your head before vanishing a second later. This is the place to ask those questions. (Start writing them down, please.) Don't be afraid. Nobody will laugh at you here.



Q

Exactly how deep can a human being travel underwater using current technology?

The deepest point ever reached by man is 35,858 feet below the surface of the ocean, which happens to be as deep as water gets on earth. To go deeper, you'll have to travel to the bottom of the Challenger Deep, a section of the Mariana Trench under the Pacific Ocean 200 miles southwest of Guam. And you're going to need a shovel.

Two expeditions have successfully plumbed the almost-7-mile depths of the Challenger Deep. In 1960 U.S. Navy Lt. Don Walsh and Swiss oceanographer Jacques Piccard (no relation to Jean-Luc) sat through a nearly 5-hour descent in a submersible, then spent 20 just-to-say-we-did-it minutes on the bottom before surfacing. In 2012 director James Cameron repeated the feat in *Deepsea Challenger*, a one-seater made chiefly of syntactic foam—a blend of tiny glass spheres and epoxy resin that

not only floats (a good thing in a submarine, assuming one doesn't want to remain underwater forever) but also stands up to the extreme pressures at that depth. Cameron's quasi-candy-bar-shaped craft was able to make the trip in half the time. He collected some data from the bottom, but, alas, no car keys.

Now, if you're talking just a guy in the water, no cozy little capsule, the answer becomes less definitive. Officially, divers employed by the French underwater exploration outfit Comex (Compagnie Maritime d'Expertises), breathing carefully formulated gas mixtures and employing an elaborate pressurization regime known as saturation diving, hold the depth record of 1,752 feet. Unofficially, at least one person in a position to know suggests U.S. Navy divers may (wink, wink) have surpassed that depth, but details are, you guessed it, "classified."



Why aren't there more cell towers?

Why does your floor smell of chowder? There's a guy named Mel in your shower? Huh? What? Hang on. Call me back.

Ah yes, much better. Cell towers—why aren't there more of them? Turns out it's

not as simple as one might think. Consider this, for starters: Would the sudden appearance of a happy little cell tower . . . right . . . over . . . *here* enhance the real-life Bob Ross painting that is your backyard vista? Nobody else thinks so either. The nation is already home to some 190,000 cell towers (up from 900 in 1985), but wireless providers face myriad challenges in siting new ones. Nimbyism, reflected most often in local zoning ordinances, is one issue. But the feds have plenty of their own obstacles. Even a skeletal list of regulations is reminiscent of those encyclopedic side-effect disclaimers that accompany ads for any pharmaceutical stronger than foot powder. Wildlife habitats, historic and cultural sites, wetlands, and residential neighborhoods where radio-frequency radiation (or high-intensity white floodlights) might harm or annoy people are all off-limits, to name a very few of the more obvious restrictions.

Many of the rules likely make sense, but they don't make it easy for cell companies to bolster your coverage with new towers. Got a beef? Call your congressman—on a landline.

Are carnival rides safe?

Nothing is entirely safe—other than a bet that no matter how many times you throw that softball at those leaden milk bottles, at least one will remain standing. But statistics suggest that carnival rides are safer than they feel, so long as operators keep their eyes on the ride and off the passing parade of tube tops, and riders don't do anything stupid.

The International Association of Amusement Parks

and Attractions calculates the odds of suffering a fatal injury on a ride at fixed-site amusement parks (Disney, Six Flags, et al.) at one in 750 million. You're about twice as likely to suffer a shark attack as you are to sustain an injury requiring a hospital stay. Plus, there is absolutely no chance you'll suffer a shark attack while you're on the Tilt-A-Whirl, so factor that in on the plus side. Nobody breaks out injury stats specifically for traveling carnivals, though most are subject to regular safety inspections.

Accidents are inevitable, but they seldom result from mechanical failure. More often, slack-jawed operators space out as riders fail to properly secure themselves. Some geniuses try to stand up while rides are under way, which can put them at the head of the line for a somewhat-less-thrilling ride in an ambulance. Children require particular attention: Certain safety bars only close to the point where they're snug against the largest passenger. If an adult rides next to a kid, the child is inadequately secured. But if people exercise common sense (maybe skip Methhead Mike's Magic Mineshaft), they're likely to walk away unscathed. Corn dogs and funnel cakes—those are the true killers on the midway. ■



Got a question for Great Unknowns? Email greatunknowns@popularmechanics.com. Questions will be selected based on quality or at our whim.

COMFORT NEVER LOOKED SO GOOD

Lee®
----- Est. 1889 -----

THE NEW LEE MODERN SERIES



MADE WITH LEE



DESIGNED TO MOVE WITH YOU

ACTIVE COMFORT DENIM

TRY ON A PAIR AT KOHL'S®

[/leejeans](https://www.facebook.com/leejeans) [@leejeans](https://twitter.com/leejeans)

© 2014 VF Jeanswear Inc.

PROGRESSIVE
COMMERCIAL

1-800-PROGRESSIVE
PROGRESSIVE.COM

LANDSCAPER

FLO

**\$AVING YOU MONEY ON YOUR
COMMERCIAL AUTO INSURANCE!**

NOW WITH AWESOME
**DISCOUNT
ACTION!**

- SAFE DRIVER•
- BUSINESS EXPERIENCE•
- PAID-IN-FULL•

**COLLECT
THEM ALL!**



FOR USE WITH ALL MIDSIZED
COMMERCIAL VEHICLES!





CARS

Going Fast

There's nothing like the rush of acceleration. But speed comes in many forms. Here are five cars that will keep you entertained—plus a Subaru.

The Ringer

2015 BMW M3 AND M4

PRICE: \$62,000/\$64,200

AVAILABLE: NOW

MPG (CITY/HWY): 17/26

Unless you're in a dragster, going fast in a straight line is actually pretty boring. The fun kinds of speed happen on back roads, through twisty corners that knock you around like a rickety carnival ride. And for that, there's the M3. A product of BMW's motorsports

performance division, the M3 has always been the alpha of the 3 Series line, with more power and increased cornering capabilities. And, thankfully, this fifth generation adheres to the basic criteria of the 1980s original: a rollicking thrill machine without a supercar price tag. Not everything is perfect, though. Both the M3 and its coupe version, the newly coined M4, are heavier and more complicated, thanks to modern regulations and technology creep. The steering feel is also duller and the engine note continues to become more muted. That's a bummer, but we got over

it because both cars are still highly addictive. Much of that is due to the new engine, a 425-hp twin-turbo inline six devoted to brutish amounts of unapologetic torque. It's transforming: With those 406 lb-ft available at only 1,850 rpm, you get an immediate surge of power even at very low speeds. On the road that translates to a quick exit from any turn. And at the track both cars are more than game to go sideways around a corner with smoke pouring from the rear tires. It's crazy, ridiculous fun. In other words, it's a proper M3.

— JASON HARPER





The Steal

2015 VOLKSWAGEN GOLF GTI

PRICE: \$25,215/\$31,515

AVAILABLE: NOW

MPG (CITY/HWY): 25/34 MANUAL;
25/33 AUTOMATIC

The Volkswagen Golf has always been a special combination of performance and quality at a bargain price. But it's the GTI, the high-performance version of the base car, that really makes Golf lovers giddy. And this newest GTI doesn't disappoint—the car just *goes*. Riding on a new platform, it's 82 pounds lighter than the previous generation, and its turbocharged four now puts out 210 hp and 258 lb-ft of torque—gains of 10 hp and 51 lb-ft. The six-speed manual is crisp, and the GTI's electrically assisted steering is remarkably precise, even against traditional hydraulic racks. Alone, the GTI could take the title of best new hatchback. But equipped with the \$1,500 Performance Package, the GTI becomes truly exceptional. For that extra cash you get 10 more horsepower, larger brakes, Volkswagen's newest limited-slip differential, and an optional adaptive damping system to sharpen the suspension tuning. The differential monitors the car's stability systems and wheel sensors to proactively fight understeer, that moment when you turn the wheel but the car doesn't follow. The system works perfectly, defying our every attempt to find a crack. In fact, we couldn't find anything wrong with this car. — JAMES TATE

T

he Volkswagen Golf has always been a special combination of performance and quality at a bargain price. But it's the GTI, the high-performance version of the base



The Classic

2015 ALFA ROMEO 4C

PRICE: \$55,195

AVAILABLE: FALL 2014

MPG (CITY/HWY): 24/34

Until now owning a vehicle that blends Italian performance with craftsmanship and beautiful bodywork has required Wall Street capital. But after a 19-year absence, Alfa Romeo finally returns to the States with an exotic for (some of) the rest of us. The 4C is pure sports car. The manual steering is so direct and communicative that it requires constant attention and correction—a fair price for this level of control. The car is quick, too, using its 237-hp turbocharged four cylinder and a swift-shifting, twin-clutch gearbox to hit 60 mph in 4.5 seconds. Better yet, the engine sits right behind your head, nearly naked under its thin cover, buzzing, popping, and filling the cabin with a wonderful *whoosh* every time the turbo spools up. You hear everything in this car, and that makes it fun to drive



Discover the Secrets You Need to Succeed!

Over 1,037
essential skills
every man
needs to
know...

Esquire's *The Biggest Black Book Ever* is THE essential guide for successful men. Read it FREE for 21 days and get a FREE GIFT!



Get Esquire's *The Biggest Black Book Ever*—FREE for 21 days.

This essential edition is your personal roadmap to success in everything from work, women, and grooming to etiquette, wardrobe, black tie events and more. With wit and authority Esquire's experts reveal:

- 4 shirts every man should own. Style secret is on page 117.
- 3 things you should never bring to a meeting. See page 12 for more smart office tips.
- Get fast service at a crowded bar. Page 73 makes you a happy-hour hero.
- Make an off-the-rack blazer look like it was tailor made. Page 109.
- 3 secrets for beating jet lag. Read page 21 and feel great the moment you land.
- How to check out women without getting caught. Page 34 is a lifesaver.
- And so much more!

NOT AVAILABLE IN STORES!
Go to: www.Esquire.com/biggest



Authentic Historical
Reproductions

We found our most important watch in a soldier's pocket

It's the summer of 1944 and a weathered U.S. sergeant is walking in Rome only days after the Allied Liberation. He's only weeks away from returning home. He finds an interesting timepiece in a store and he decides to splurge a little on this memento. He loved the way it felt in his hand, and the complex movement inside the case intrigued him. He really liked the hunter's back that opened to a secret compartment. He thought that he could squeeze a picture of his wife and new daughter in the case back. Besides the Purple Heart and the Bronze Star, my father cherished this watch because it was a reminder of the best part of the war for any soldier—the homecoming.

He nicknamed the watch *Ritorno* for homecoming, and the rare heirloom is now valued at \$42,000 according to *The Complete Guide to Watches*. But to our family, it is just



The hunter's back

The Ritorno watch back opens to reveal a special compartment for a keepsake picture or can be engraved.

a reminder that nothing is more beautiful than the smile of a healthy returning GI.

We wanted to bring this little piece of personal history back to life in a faithful reproduction of the original design. We've used a 27-jeweled movement reminiscent of the best watches of the 1940s and we built this watch with \$26 million worth

of Swiss built precision machinery. We then test it for 15 days on Swiss made calibrators to ensure accuracy to only seconds a day. The movement displays the day and date on the antique satin finished face and the sweep second hand lets any watch expert know that it has a fine automatic movement, not a mass-produced quartz movement. If you enjoy the rare, the classic, and the museum quality, we have a limited number of *Ritornos* available. If you are not completely satisfied, simply return it within 30 days for a full refund of the purchase price.

Stauer 1944 Ritorno ~~\$147~~ Now only \$99 + S&P

800-806-1646

Promotional Code RTN343-02
Please mention this when you call.

To order by mail, please call for details.

Stauer®

14101 Southcross Drive W., Dept. RTN343-02
Burnsville, Minnesota 55337 www.stauer.com



GOING FAST

at any speed. Of course, there's almost zero rear visibility, but on the plus side those cool side-mounted air intakes for the engine are constantly filling the mirrors. The

car has three drive modes, but you'll want to leave it set in Dynamic, where the throttle is sharpened, the gearbox shifts 25 percent faster, and the stabil-

ity control isn't as intrusive. Riding on a carbon-fiber chassis, the 4C is light, weighing just 2,465 pounds. That makes the car extremely agile and firm, if a

bit fidgety on rough pavement. With hardly any trunk room and enough cabin space for you, your phone, and maybe a bottle of water, the 4C is probably too

performance-oriented and raw to be a daily driver for most. But that's fine. If you're logging hours in the car-pool lane, you've missed the point.

— BEN STEWART

The Fantasy

2015 LAMBORGHINI HURACÁN LP 610-4

PRICE: \$245,000 (EST.)

AVAILABLE: NOW

MPG (CITY/HWY): 15/22 (EST.)

Horsepower and raw speed do not the ultimate vehicle make. Sure, the Huracán has both, with 602 hp that will push the car beyond 200 mph if you have enough pavement. But now Lambo has also added fighter-jet-like reflexes to its arsenal. Tucked into the floor, right near the Huracán's center of gravity, is the carmaker's Piattaforma Inerziale (literally, "inertia platform"), a black box with three gyroscopes and three accelerometers that track physical orientation and gauge momentum. Most cars depend on a single gyro, but with three the Huracán can instantly determine the vehicle's yaw, pitch, and roll. That means the car's systems—stability control, four-wheel drive, and the new seven-speed dual-clutch gearbox—can react faster and more smoothly. The result is eerily good performance.

Dive into a hairpin and the car balances out the braking at each wheel for maximum stability while doling out the perfect amount of power for when you get on the gas. No matter your skill level, the Huracán makes everyone behind the wheel feel like a superhero. The quarter-million-dollar price tag puts it out of reach for most, but remember: Volkswagen Group owns Lamborghini, so eventually this tech could trickle down to more mainstream cars such as the GTI. That's an exciting thought.

— MICHAEL AUSTIN



BALANCING ACT The Huracán's three gyroscopes give it unbelievable performance, but gyros can also be used to maintain balance. In 1914 Russian count Pyotr Shilovsky demonstrated the first gyrocar, a two-wheeled vehicle stabilized by gyroscopic forces. Since then there have been a few other prototypes, but none has seen production. Lit Motors hopes to make its electric C-1 the first mainstream gyrocar. The C-1 uses two gyros to stay upright and a 10-kwh battery for power. Standing still, it's so stable that you can kick it and it won't fall over, though we doubt insurance covers that. — ANDREW DEL-COLLE

Finding a parking spot should be easy.





Air goes here—
through the
parking lamp.



The Muscle

2015 DODGE CHALLENGER SRT HELLCAT

PRICE: NOT SET

AVAILABLE: FALL 2014

MPG: NA

Black or red? Which key fob would you choose? Actually, don't answer that. It's a trick question. Dodge might have two different-colored key fobs for the Challenger SRT Hellcat, but the red one is the ticket. With it you'll be able to tap the full potential—707 horses and 650 lb-ft of torque—of the supercharged 6.2-liter, eight-cylinder Hellcat Hemi engine. With the black fob the engine's output will

be limited to 500 hp and 480 lb-ft. Not only is this the first supercharged Hemi engine but it's also the most powerful V-8 Chrysler has ever made. So get excited, because there's nothing like the jaw-rattling acceleration that comes from American muscle. The first product of Chrysler's newly combined Dodge and SRT brands, the Hellcat also has a special braking system, springs,

and sway bars for unleashing the car at the track. But by far the coolest feature is its hidden ram-air intake. To reduce drag and increase airflow to the massive, oxygen-hungry engine, Dodge's engineers hollowed out the driver's side parking lamp. There's still the outer LED ring, but the inside is a tunnel that crams large quantities of air straight into the manifold. Red fob, indeed. — **A. D. C**

Now, a Word About Safety

2015 SUBARU LEGACY

PRICE: \$22,490/\$30,390

AVAILABLE: NOW

MPG (CITY/HWY): 26/36 (FOUR CYLINDER), 20/27 (SIX CYLINDER)

Nobody would confuse the Subaru Legacy and its base 175-hp engine with performance. There is the optional 256-hp six cylinder, but this is a family car first and foremost. That doesn't mean it's boring, though. This newest Legacy ditches the last-gen's stodgy sheet metal for a much more refined and attractive overall package. It also debuts an updated version of Subaru's EyeSight safety system, now with color detection and a greater range and viewing angle. EyeSight uses two cameras to scan the road ahead, enabling the car's adaptive cruise control, lane-departure warning, and collision mitigation. At speeds up to 30 mph, the system automatically brakes if a collision is imminent. It can also detect brake lights or read the curve of the road to slow down the cruise-control system through corners. This is sophisticated technology that will prevent accidents. In a family car like the Legacy, that's what matters most. — **M. A.**





How to Drive Fast

Lessons from the track.

BY INGRID STEFFENSEN

H

Here is what I do on weekends: I put on a crash helmet and climb into fast cars with strangers and teach them how to drive on a racetrack. I am a high-performance driving instructor, and I teach the techniques that Formula One drivers use to get around a twisty racecourse. Anyone over 18 with a sporty car (or even a nonsporty one; it's your money) can sign up to learn what happens when you get your Audi up to 120 or actually jam on the brakes as hard as they were meant to be jammed on. And while you should never drive to the grocery store the way we drive on the track, the principles we teach can make you a better and more conscientious

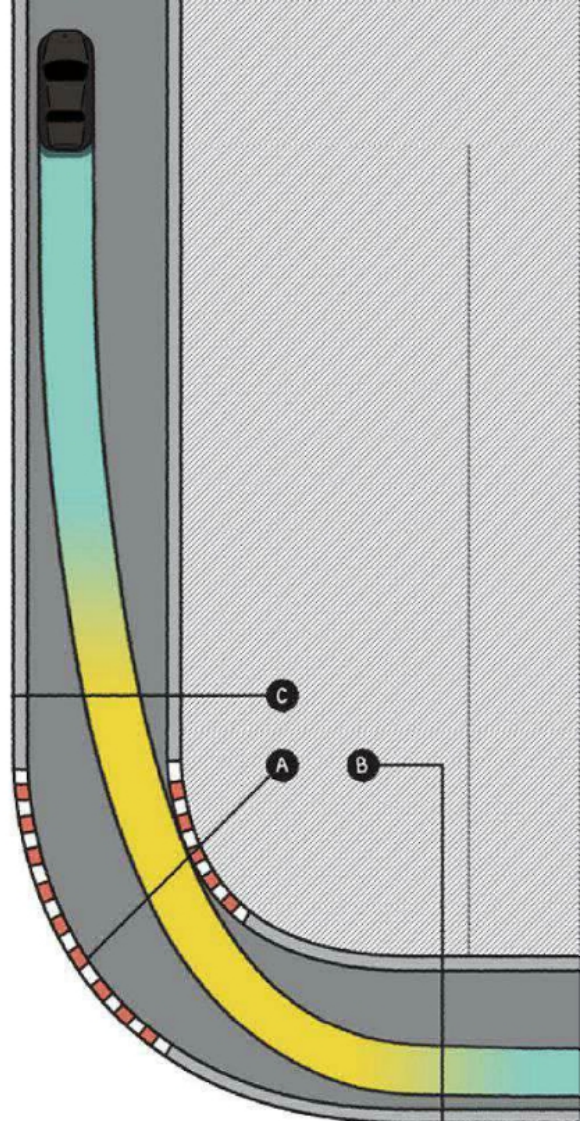
driver. And they're fun.

When I instruct a track newbie, the first item of business is what we reverentially refer to as The Line (see right). The Line is simple in theory but, like using a saber to uncork champagne, somewhat trickier in practice. Cars go fastest in a straight line. The less you ask them to turn, the faster they can go. Ergo, the fastest way through a turn is the one that rides the longest radius. When you're driving on the street, your line is pretty much determined for you by the Department of Transportation. But instead of hugging a corner, start at the outside of your lane and try to flatten out the arc of your turn with the little room you have. Slow down before the turn, not in the middle, and accelerate only when you're coming out of it.

Then there's the contact patch, the four little pieces of grippy real estate where the rubber meets the asphalt. Braking maximizes tire contact in the front, accelerating transfers it to the rear, and turning shifts it from side to side. Since your car is most stable when its weight is evenly distributed, it's important to remember that the more you ask the vehicle to do one thing (turning), the less it can do of another (braking or accelerating). Once they have that in mind, most of my novice students are astonished by their cars'—and their own—ability to maintain speed throughout a turn or to stop the car quickly when the situation demands it.

The most valuable exercise I do with my students, however, involves vision: You have to look much farther ahead than your instincts tell you. That's where you'll see the effects of the driving decisions you make. When my students take their eyes off the hood and redirect them from the entry to the exit of the turn, their inputs become smoother, and, no surprise, their cars become faster. You can do the same thing on the street. Look where you want the car to go, not where it is.

Oh, and always wear your seatbelt. But maybe not the helmet. ■



A THE LINE. Racing turns should be as flat as possible to minimize steering and retain speed. As you approach a turn, position your car to the outside edge of the track for entry, or turn-in. At the apex of the turn, try to run over the road's inside edge before moving back toward the outside on exit.

B BRAKING. The approach to a turn is your brake zone. Race-track braking is the opposite of street braking: You begin by hitting the brakes as hard as you can, then tapering off as you enter the turn. As you near the apex, your foot rolls smoothly off the brake and you apply maintenance throttle—just enough gas to maintain your speed.

C ACCELERATION. When you've passed the apex, give it more and more gas as you unwind the wheel. Once you're straightened out, your foot should be to the floor.

Because one tank is better than eight.

It takes up to eight tanks for competitive formulas to achieve the results from just one tank of CRC 1-TANK Power Renew®. Our concentrated complete fuel system cleanup delivers proven results that you'll notice when you step on the gas and when you reach for your wallet.



5.7% MPG
Potential Increase



ANNUAL SAVINGS
Over competitive products



TOTAL POWER RESTORATION

To renew your car's power, just pick up CRC 1-TANK Power Renew® at your local auto parts store. Visit CRC1tank.com to discover even more powerful savings with a \$5 rebate.



CRC1Tank.com



TRY A DR® FIELD AND BRUSH MOWER WITH OUR 6-MONTH TRIAL!



Put one to the test on your own property.

The DR® FIELD and BRUSH MOWER isn't complicated. It's overbuilt, so you don't need to second-guess where you take it. When you're behind a rugged steel deck propelled by all-terrain tires, with a six-pound blade swinging at 195mph, you're calling the shots.

TOW-BEHIND models also available!



- FLATTEN 3" THICK SAPLINGS
- DEVOUR 8' HIGH WEEDS AND BRUSH
- CUT A SWATH UP TO 30" WIDE
- GO ANYWHERE



DRfieldbrush.com

84571X © 2014

Self-Feeding DR® CHIPPER

Just load a DR® RAPID-FEED™ CHIPPER, step back, and watch it chew up 5½" thick branches!



TRACTOR OWNERS
3-Point Hitch model too.

SELF-FEEDING saves time and energy. Most branches can be dropped into the hopper and will self-feed, instead of you having to force-feed them.

TOP-DISCHARGING is standard on all models, for easily collecting discharged chips in a container or cart.

PRO-SPEC™ CHIPPER KNIFE is made of forged alloy tool steel, making it exceptionally strong with an excellent edge-holding ability.

DRchipper.com

84572X © 2014

FREE SHIPPING
FOR A LIMITED TIME. SOME LIMITATIONS APPLY.

Try a DR® at Home for 6 Months!
Call for details.

Call for a **FREE DVD and Catalog!**

Includes product specifications and factory-direct offers.

TOLL FREE **800-529-0155**



Keeps Paint Out. Keeps Lines Sharp.®



FrogTape® is the only painter's tape treated with PaintBlock® Technology. PaintBlock forms a micro-barrier that seals the edges of the tape, preventing paint bleed. Visit FrogTape.com to see PaintBlock in action, get painting tips and more!



FrogTape.com

877-FROGTAPE
(376-4827)

PATENTED

FROGTAPE

Keeps Paint Out. Keeps Lines Sharp.



SKILLS

THE HARDWARE LEXICON

ACE VS. TRUE VALUE

IMPACT DRIVERS

CLEAN HANDS



The Great American Hardware Store

*An appreciation.
By Ted Allen*

Mean Hardware Guy worked fasteners—screws, nails, bolts. Probably still does. Back in the late '90s and early oughts, Mean Hardware Guy was my favorite staffer at my favorite hardware store, Clark-Devon Hardware in Chicago (where the latter word is pronounced "de-VAHN"), and certainly not for his personal effervescence. He was, and inevitably still



is, brusque, wearily but quickly turning from one weekend bumbler to the next, almost seeming to enjoy the cluelessness of the questions, always setting things right with the answers. He saw me through the renovations of two turn-of-the-century heckholes, generally opening the dialogue with, "What are you *trying* to do?" He dispensed his wares from bins, not blister packs, counted out the exact number you needed and not a wingnut more, dropped them into little brown paper bags and priced them not with bar codes but pencil stubs. Which he probably sharpened with his teeth.

Clark-Devon Hardware had (and probably still has) *everything*, meaning you almost never needed to drive out to a big-box airplane hangar.

Ever since I was a kid, independent hardware stores have always been places of wonder, full of grizzled men who could make stuff and fix stuff and would tell you how to, too. The best Hardware Guys therein are always old contractors (hardware stores are the PGA seniors tour for construction guys), fingertips raw from sandpaper and Wire-Nuts, happy (enough) to work their endgame indoors,

I SHOP AT MY LOCAL PLACE, OWNED BY GUSTAVO AND STAFFED BY HIS SONS. IT'S SMALL, BUT THEY KNOW THEIR STUFF.

amid shelves-full of flashlights, hatchets, and balsa-wood airplanes, bins loaded with bolts, springs, and magnets, and gumball machines that benefit the Lions Club.

My first store was Mahan's Ace Hardware on Main Street in Carmel, Indiana, to which I could ride my bike in 10 minutes. Clark-Devon was (and surely still is) that kind of hardware store, owned by the same family since it opened in 1924. It's dusty and idiosyncratic, cobbled out of two or three tired brick buildings that include a vaudeville-era theater, floorboards worn from years of work boots and salt. It smelled of machine oil and burnt coffee, the latter served to tradesmen in Styrofoam cups. Between customers the checkout ladies watched a tiny television.

You save this weekend bumbler enough times, Hardware Guy, and you own my loyalty forever.

For years the old-fashioned hardware store has seen its numbers dwindle, not only because of the promise of lower prices at home centers but because of Internet inter-

lopers, bumpy economies, landlords who can charge higher rent to branch banks. During the decade ending in 2010, according to the Institute for Local Self-Reliance, the number of independents in the U.S. fell by 854, to 12,122. But during that period, their sales grew enough to keep overall revenue steady.

Myself, I'm bullish. I shop at my local place, Clinton Hill Hardware in Brooklyn, New York, owned by a guy named Gustavo and staffed mostly by his sons. The store is too small to always have everything I want—you could fit two of them in Home Depot's tool corral alone. But they know their stuff. A high schooler in a big-box vest can tell you that the duct tape lives half a mile away in aisle 1,752, but guys like Gustavo and Mean Hardware Guy and the descendants of the founder of Mahan's can tell you which trowels are for skim coating, which brand of screwdriver has lasted him the most decades, and why you need a hammer drill to attach your porch light to the brick. For that kind of knowledge, a little mean is worth it.

TIME TRIAL

Time is valuable when you only have a few hours to complete a weekend DIY project. So, we visited a hardware store and a home center on a quiet Tuesday afternoon and timed how long it took to find a few items, get a key cut, and then return to our car. For fairness, we chose two stores we know well.

SHOPPING LIST:

- box of screws
- brick trowel
- cartridge faucet valve
- ½-in. open-end/box-end wrench
- 1 gal. latex primer
- single-pole light switch
- toilet seat
- tube of latex caulk
- wasp spray

RESULTS:

HARDWARE STORE	HOME CENTER
8 minutes	28 minutes

The hardware store was small enough that we could work our way in a straight line from one aisle to the next, whereas the large home center required several backtracks. And we had to return the key made at the home center, as it didn't operate the deadbolt.

HISTORY OF HARDWARE STORES



1782

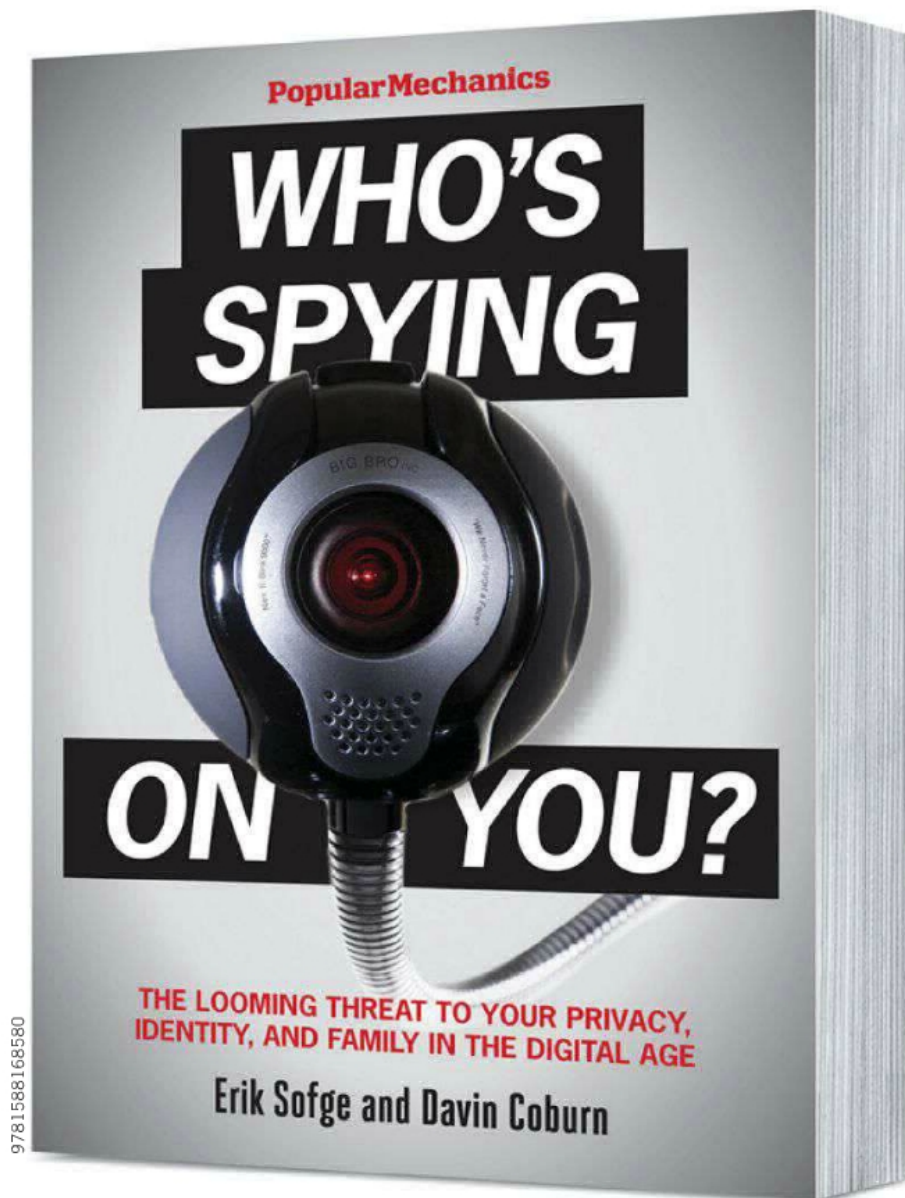
The future Elwood Adams Hardware opens in Worcester, Massachusetts. Proprietor Daniel Waldo traffics in saddles, oil lamps, shovels, hand tools, and more.

1787

Paul Revere announces that his shop is moving from Dock Square to No. 50 Cornhill, Boston, where he has for sale "a general assortment of hardware." Two years later Samuel Torrey advertises his Dock Square "hard-ware store."

YOU'RE NOT PARANOID.

YOU ARE BEING WATCHED.



Today, our every activity can be quietly monitored, from who our friends are to all of our financial transactions. And with medical records in the “cloud” and imminent gene sequencing, even our bodies are up for grabs. What can we do? From phone hacking to identity and credit theft, *Who's Spying On You?* tells the stories of real people whose privacy has been violated, describes the technologies used to intrude, and reveals how we can protect ourselves in a world filled with spies.

AVAILABLE IN PAPERBACK OR AS AN EBOOK WHEREVER BOOKS ARE SOLD

HEARST BOOKS

How to Use a Hardware Store

PLUMBING

Leave large parts in the car. For example, measure the spacing of a faucet's water inlets, spout length, and mounting width. You can always go and get it if you need to refer to it.

HARDWARE

Reduce trial-and-error fitting. Use a screw pitch gauge to check the thread of odd-size or metric bolts before visiting the store.

Remember that pen that you brought in? Use it to mark your bags of loose hardware. The pen on the string never works.

HAND TOOLS

Shop for these around Father's Day. The deals are better than Black Friday, Cyber Monday, and the winter holiday season combined, says website fatwallet.com.

BEFORE YOU ENTER

- Bring a small notepad and pen, the part you're replacing, a tape measure, and your phone to take reference pictures.
- Shopping for a snow shovel or some other tool that you'll use while wearing gloves? Bring a pair to check the tool's handle for comfort and fit.
- Shopping for paint? Don't forget your square-footage estimate.

Double-check that bags of hardware are all correctly marked.

Now's as good a time as any to pick up batteries for your smoke detectors.

1869

Elwood Adams Hardware takes its current name after being purchased by one of its young employees, Elwood Adams.

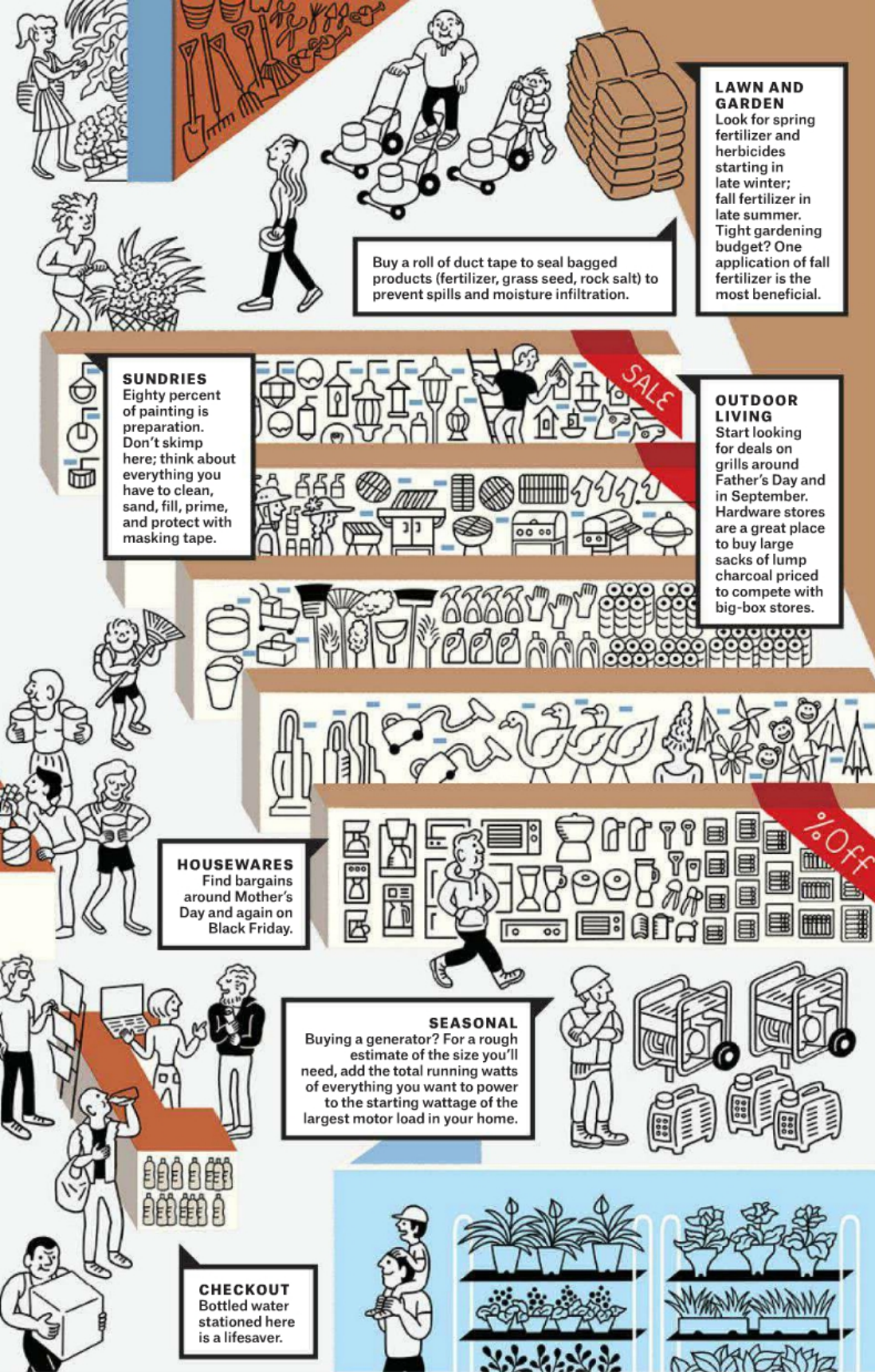


1897

The Sears, Roebuck & Co. Catalogue—the Amazon of its time—expands its offerings by introducing a Builder's Hardware and Material section.

1906

Michigan's The Aladdin Company starts selling kit homes. Sears joins the game in 1908, creating a need to supply consumers with hardware.



LAWN AND GARDEN

Look for spring fertilizer and herbicides starting in late winter; fall fertilizer in late summer. Tight gardening budget? One application of fall fertilizer is the most beneficial.

Buy a roll of duct tape to seal bagged products (fertilizer, grass seed, rock salt) to prevent spills and moisture infiltration.

SUNDRIES

Eighty percent of painting is preparation. Don't skip here; think about everything you have to clean, sand, fill, prime, and protect with masking tape.

OUTDOOR LIVING

Start looking for deals on grills around Father's Day and in September. Hardware stores are a great place to buy large sacks of lump charcoal priced to compete with big-box stores.

HOUSEWARES

Find bargains around Mother's Day and again on Black Friday.

SEASONAL

Buying a generator? For a rough estimate of the size you'll need, add the total running watts of everything you want to power to the starting wattage of the largest motor load in your home.

CHECKOUT

Bottled water stationed here is a lifesaver.

Skills

The Suggestion:

HARDWARE-STORE HOLIDAY SHOPPING

You could do it, if you had to. You could do all your holiday shopping at your neighborhood hardware store. In, like, 20 minutes. No mall, no spending another 20 bucks so you get free shipping. Because the great thing about hardware stores is that they're packed so tight, you never know what you're going to find. Think—you could get your dad a Leatherman, because every man needs a multitool, and if he already has one, he probably doesn't have one in his glove compartment, and he should. Or a nice pair of binoculars. You could get your mom a high-quality wooden cutting board, which they always seem to have in housewares, and a decent kitchen knife. You could get your kid his or her first toolbox and fill it with a few essentials—a tape measure, a screwdriver, that kind of thing. You could get your brother an impact driver if he's handy, and some andirons if he's not. You could get your sister a teapot. Or some andirons. You could get your brother-in-law a wall clock. You could get your neighbor—the one who always lets you use his tools—a good tool bucket. You could get all the stocking stuffers you need—mini flashlights, key chains, pocketknives, beef-jerky sticks, yo-yos, reversible screwdrivers. You could get your wife—wives are tough, actually. You might not want to shop for your wife at the hardware store.



1924

Four hardware store owners in Greater Chicago form a cooperative to purchase products in bulk. They name their company Ace Stores, Inc.

1946

Carl Buchan of North Wilkesboro, North Carolina, buys out his partners at the hardware store where he works. He opts to source his wares directly from manufacturers. Lowe's is born.

1963



John Cotter purchases a Chicago hardware mainstay called Hibbard, Spencer, Bartlett & Company. He also purchases one of their trademarks: True Value.



THE COLLECTED WISDOM OF

JOHN WASLENKO, 63,
Owner of
THORNIDGE
HARDWARE SUPPLY,
Levittown, Pennsylvania

This is a family-owned and -operated store. My dad bought it in 1967. It was an existing hardware store.

I was 16 years old. Our high school was right across the street, so I used to just cut across the field and come to work after school, stocking and cleaning shelves and organizing merchandise.

We pretty much ran it together. We were always questioning each other. He passed away in '95 of cancer, and I've been running it ever since.

We're in a development that was built by William J. Levitt. So we have 24,000 homes that were built in the '50s to support the people who worked for U.S. Steel. Between that and General Motors and 3M Company, everyone was employed by very large manufacturers.

You get maintenance men in from apartments or some of our industrial plants and they're asking you questions about how to do something. They know that we know what we're talking about.

We're in our third generation here. My son Dan is in the store now. You'll see the old-timers come in and they're in their 70s and 80s now. They're coming in with walkers, but they're still coming here, after 47 years.

Dan's 25. He does all the computer stuff. Kids love everything computers. So he does the inventory. He'll take care of all the defective merchandise. He runs all the reports.

You have to be on top of your inventory. It's too costly not to be. Inventory is the key to survival.

We can go start to finish on a project and give a person everything he needs, because most of us here have already done that project.

It's kind of like you're a bartender. Everyone has a story to tell you.

We get tradesmen who do what they do five days a week—they know the shortcuts. They tell you what makes the job a whole lot easier, and then you can turn around to a customer and say, "Hey, this guy was just in. He told me how to do this. It'll probably work for you."

We've got guys who are working on a faucet or hooking up a drain. It's like, "This is my fourth trip today." They're the kind of guys you want to joke around with and have a good time. They're wasting time, but they're having fun.

Hard work pays off.

I've seen 14 hardware stores come and go in our area, and yet we're still here.



The Ace and True Value hardware-store cooperatives run neck and neck in a battle for supremacy.

DATE OF FOUNDING

1924

early 1930s

HEADQUARTERED

Oak Brook, IL

Chicago, IL

NUMBER OF STORES

4,875 +

4,500 +

2013 SALES

\$4.2B

\$5.5B

How to

SPEAK HARDWARE STORE

CEMENT: Not synonymous with concrete but an ingredient in bagged concrete and mortar mixes.

IRON: A common misnomer applied to steel bars, sheets, and rods.

NAILS: Nails are described by a number followed by the letter "d", pronounced "penny." Why? That was the Roman symbol for the penny in 15th-century England (used until 1971). A likely theory holds that this gave the price for 100 nails. For example, 100 3½-inch nails cost

16d; they became known as 16d.

PIPE/TUBE/HOSE: A pipe is a thick-walled cylinder for transporting liquid or gas. A tube has a thinner wall and is more flexible than pipe. A hose is even more flexible than a tube and is usually coiled.

SOLDER: Used in electronics or to join copper pipe, tubing, or sheets. A brazing rod is used to connect refrigeration tubing.

ALKYD PAINT: Pronounced "al-kid." It gets its name from "alcid," a blend of the words alcohol and acid.

Common Genericized Trademarks

SKILSAW =
circular saw
SPEED SQUARE =
rafter square

SHEETROCK =
drywall
LINOLEUM =
vinyl flooring



1979

The first two Home Depot stores open in Atlanta. The stores are massive warehouses that provide one-stop shopping for everything a DIYer or contractor could need.

1980

Elwood Adams Hardware is added to the National Register of Historic Places.

2014

Amazon increases price pressure on hardware stores and home centers. However, market research shows that most products can still be found at a lower price in brick-and-mortar stores.



TOP
SHOP
2014

FORM + PERFORM



THE ART OF THE STANCE

{ Galpin Auto Sports (G.A.S.) transforms an off-the-lot car and motorcycle into tastefully tuned stunners. The 2014 mission: a drift-worthy personalized car and two-wheeled sidekick that ride as well as they show. }

PERFECT POSTURE: LOWERING AND TUCKING WITHOUT SCRAPING

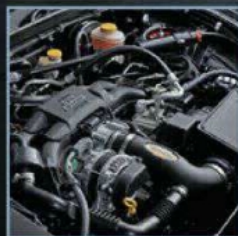
**TUNER TRICKS FROM
NORTH AMERICA AND
ASIA DEFINE THE TOP
SHOP SUBARU BRZ AND
KAWASAKI NINJA 650.
THE CAR IS A STREET-
LEGAL TRACK STAR: GRAN
TOURISMO EXECUTED IN
LITERAL REALITY. THE
BIKE IS PEELED DOWN.
THEY'RE FAST AND
SERIOUSLY FURIOUS.**



KAWASAKI NINJA 650

Kawi Lime Green and Flat Black gave way to Dupli-Color Sublime Green and Mineral Gray. G.A.S. tightened up the Ninja's lines with a sleeker windshield plus compact mirrors and tail lights.

No 1



BETTER BREATHING

The BRZ's 2.0L Boxer four-banger's aspiration is improved with an Airaid intake system and a free-flowing Buddy Club exhaust. The adjustable coilovers also colorize the engine compartment.

No 4

TIRES & WHEELS

Sticky Falken Azenis FK-453s on VIP Modular VRC13 wheels are drift-inspired: 215/35R19s on 19x8.5s in the front and 245/35R19s on fatter 19x10.5s for the rear.

No 5



PAINT SHOP FINISH SYSTEM

Dupli-Color's spray-at-home-friendly lacquer in Mineral Gray Metallic is uniquely understated. Sublime Green Pearl stripes swoop onto the roof — and also pop up on select accessories.

2



CUSTOM INTERIOR

The Subaru seats are reupholstered in Katzkin leather with suede inserts. Complementary steering wheel leather includes a 12:00 stripe. Contrasting stitching is the uncommon thread.

3

TOP
SHOP
2014

FORM + PERFORM



SUSPENSION

Race-ready Eibach Multi-Pro R2 coilovers allow ride height to be lowered up to two inches in the front and 1.6 inches in the rear.

6

BODY KIT

Carbon-fiber sculpting: MV Designz front lip, side skirts and rear diffuser are augmented by a weight-saving Seibon OEM-style hood.

7

THE BEFORE

In showroom trim, the 200-horsepower, rear-wheel-drive Subaru BRZ is some of the most affordable fun in the sport-compact game (right). The Ninja 650 is an enduring champ of the sport/commute class (far right).

8





WITH THE CREW FROM
GALPIN AUTO SPORTS



**FAMOUS FOR
HOSTING THE "PIMP
MY RIDE" TV SHOW,
G.A.S. IS ONE OF THE
COUNTRY'S PREMIER
CUSTOMIZERS. THEY
DO EVERYTHING
FROM BASIC TIRE/
WHEEL UPGRADES
TO HIGH-PROFILE
CORPORATE IMAGE
VEHICLES.**

What's the theme for the Top Shop Subaru BRZ?

DOUG BREUNINGER, CAR DESIGNER: Youthful, tuner-inspired personalization. The goal is to command attention from both the drifters and the "stance" community. Colors are key: Dupli-Color Mineral Gray is inviting and brings out the bodylines. Sublime Green stripes are energetic. Extending them onto the roof was inspired by the Lotus Evora GTE.



19

**LINE ITEMS ON
THE BRZ & NINJA
BUILD SHEETS**

5 YEARS

Top Shop Timeline:
BLOWN MUSCLE, OPEN-AIR PONY,
FAMILY ADVENTURE, OFF-ROAD RALLY
AND THIS YEAR'S VIDEOGAME-
INSPIRED FUN.



CHEVY CAMARO 1SS



FORD MUSTANG



HONDA PILOT



MINI COUNTRYMAN



SUBARU BRZ

402

COMBINED LABOR HOURS CUSTOMIZING THE **SUBARU BRZ** AND **KAWASAKI NINJA 650**



How does G.A.S. decide on the modifications?

STEVE MCCORD, GM: For the Top Shop vehicles, we get recommendations from Popular Mechanics and the project sponsors, then rely on our preferred vendors. Mechanix Wear is one example of a G.A.S. go-to company. The BRZ was largely built by hands wearing their Grip gloves.



How was the proper stance achieved?

ERIC PERCIFIELD, SALES SPECIALIST: Falken Tire gave us insights based on their in-depth involvement in drifting. That explains the larger rear tires/wheels, which also plays up the rear-wheel drive. Eibach coilovers and Buddy Club suspension arms allow us to optimize the ride height over the tires and fine-tune the handling.



How was the bike customized?

JD HENDRICKSON, LEAD FABRICATOR: A motorcycle is a Top Shop tradition. This year, we painted the Kawasaki Ninja 650 to match the project car. Then we gave it cleaner lines: a single seat, a smoked windshield and a license-plate eliminator kit. With motorcycle insurance coverage from Progressive, the bike we outfitted will be treated like the unique ride it is.

What are the signature G.A.S. details?

MAD MIKE, FAMOUS CUSTOMIZER: The interior is more mild than what we sometimes do. We re-covered the seats in leather with suede centers to keep butts from sliding sideways at the track. JL Audio speakers, a Stealth sub, an amp and a processor give the proper stereo imaging.



TOP SHOP
2014

Dupli-Color®

FALKEN
TIRE

MW
MECHANIX WEAR

PROGRESSIVE

Special thanks to our suppliers:

THE 2014 TOP SHOP SUBARU BRZ AND KAWASAKI NINJA 650 ARE MADE POSSIBLE BY OUR PROJECT SPONSORS: DUPLI-COLOR, FALKEN TIRE, MECHANIX WEAR AND PROGRESSIVE INSURANCE.

The State of the Flat Tire, 2014

The good news is, you won't have to kneel by the side of a highway in a puddle at midnight to change a flat tire. *By Kevin A. Wilson*

The bad news is, new technology is altering *Homo sapiens'* evolution such that, in one generation, few of us will know how to change a tire, a basic skill man has been performing for millions of years. Still, the technology shows progress in our species. The spare tire is disappearing, and standard equipment nowadays is more likely to be a canister of tire sealant—or a cell-phone to call for roadside repair. Unless, of course, you have run-flats.

Wait, what are run-flats?

A run-flat tire will run, uh, flat for 50 miles at 50 mph, enough to get you to a repair shop. It's built with stiff sidewalls so that even when deflated it can support the car. Though the technology has been around since the 1980s, the Bridgestone DriveGuard is the first to really go mainstream—and at a price that's comparable to an equivalent touring-grade tire (\$100 to \$200).

Can I put them on my old Honda Accord?

Perhaps. Run-flats should be installed only on cars that have a tire-pressure monitoring system (TPMS) that alerts the driver to a pressure decrease. That includes most new passenger cars since 2008, though the system can be retrofit on older cars.

Is it as good as a normal tire?

Earlier generations of run-flats were too heavy, too noisy, and not durable. But the DriveGuard has a taller profile that yields a better ride. We

maneuvered a Toyota Camry equipped with them through a tricky course with a deflated front-left tire. One tight corner would have pulled a flat standard tire off the rim, but the DriveGuard stayed put. Well, kind of: Bridgestone had painted a mark on the tire, so you could see that the tire had slipped a little around the wheel rim, something the engineers said is acceptable. It pulled a little under braking, and there was noticeable noise, but not the *flapflapflap* of a typical flat. On a wet course we found traction on both DriveGuard and Bridgestone's traditional Turanza to be the same.

If it works so great, how will I know I have a flat?

The tire-pressure warning light on the dash glows.

What happens if I just keep going?

In a deflated run-flat tire the internal flexing generates lots of heat, which destroys both the rubber and the underlying steel-and-fabric struc-

ture. DriveGuards feature something called cooling fins molded into the sidewalls to disperse heat. Still, they're pretty much toast after 50 miles.

So, I can't fix it?

Probably not, unless it's just a puncture in the tread and you caught it early. In most cases you'll need a new tire.

Does this mean I don't need a spare?

Well, neither run-flats nor sealant-and-compressor kits can fix a bent rim. Plus, run-flats typically have a lower profile, so they provide even less rim protection. If you break a rim, you'll miss having a fifth wheel, so if you're buying a new car and a spare is available as an option, get it. And if you see a teenager, show him how to change a tire. For the good of the species.

Molded fins on the outer edge draw heat from the tire so it lasts longer.

Reinforced sidewalls keep the deflated tire from collapsing.

A cross section of Bridgestone's run-flat tire shows how steel and rubber combine to keep you rolling. For 50 miles, anyway.



Dupli-Color® Scratch Fix All-in-1™

The ultimate tool for vehicle scratch and chip repair.

Dupli-Color® Scratch Fix All-in-1™ is the only brand with colors tested and approved by vehicle manufacturers for a perfect match to the original factory finish when restoring a scratch or chip.

The New Scratch Fix All-in-1 tool helps you fix it easy and fix it right...in your garage. Grab your color today at your local automotive retailer.

Learn How



Like Us, Follow Us, Watch Us, Visit Us



duplicolor.com



1. Prep it.

Abrasive tip removes loose paint & rust.



2. Paint it.

Pen tip for fine scratches.



Brush end for larger chips.



3. Seal it.

Clear coat to seal, protect & ensure a perfect factory matched finish.



The Popular Mechanics Guide to Situational Hand Care

Because you can't just throw them away and get new ones.

By David Agrell

IF YOUR HANDS ARE . . .

. . . GREASY

Orange hand cleaners work wonders, but those grease-dissolving petroleum distillates and bits of pumice strip nutrients from your skin and dry it out. Save [1] Gojo (\$8) for extreme grime, and other times try a natural product like [2] Fieldworks Supply Company Good Clean Mud (\$14). It uses citrus, olive, and coconut oils to break down the film, then volcanic ash to absorb it.

. . . DIRTY

If you think ahead, a pair of gloves will help you skip the deep clean completely. You can also apply an invisible coating such as [3] Blue Magic Invisible Glove (\$8). It works fine but turns slimy when it gets wet. Or you can just put on a little moisturizer. It fills the tiny fissures in your skin to keep dirt from sticking.

. . . CHAPPED

Dry, chapped skin has more surface area than healthy skin, so it grabs dirt like a Swiffer. In the worst cases, your hands can even crack and bleed. You can slather them with Vaseline, then cover them with socks overnight, or, for a less inhibiting experience, use a moisturizer after you wash your

hands. [4] O'Keeffe's Working Hands cream (\$7) will keep your loved one from wincing whenever you try to lovingly stroke her cheek.

. . . CALLUSED

You don't want to get rid of calluses—they protect your hands and provide grip for spinning wrenches and

handling lumber—but you do want to condition them. [5] Joshua Tree Healing Salve (\$17), which was developed by climbers, seals moisture into your skin with beeswax, and kills any germs with herbs. [6] Burt's Bees Hand Salve (\$9) has a milder scent and is a decent alternative.





Sleep like a bear.

The non-habit forming
sleep-aid from the
makers of NyQuil.[™]
Sleep easily.
Sleep soundly.
And wake refreshed.

• Use as directed for occasional sleeplessness. Read each label.
Keep out of reach of children. © Procter & Gamble, Inc., 2014



BOSCH PS41

RANKING: ★★★★★

PRICE: \$120
WEIGHT: 2.14 lb LAGS: 167
BATTERY TYPE AND SIZE
(AMP-HOURS): Li-ion/2 Ahr

LIKES: We like the Bosch's stubby size—it's nearly an inch shorter than the Milwaukee. We also thought a lot of its smooth and solid driving performance. And as odd as this sounds, if you're drilling and driving somewhere dark, you'll appreciate Bosch's three LEDs.

DISLIKES: Could use a two-speed selector switch and a push-to-lock chuck that operates with one hand, like its red competitor.

The Mighty Impact Driver

By Roy Berendsohn

The 12-volt impact driver is a versatile mighty mite. Driving small fasteners at low speeds and low torque, it operates like a drill driver. But its impact mechanism kicks in automatically for big fasteners such as lag screws or hexhead sheet-metal screws. This feature makes these drivers invaluable for building a deck from pressure-treated lumber or even assembling metal duct. We evaluated nine tools by driving lag screws into a 4 x 4 until the batteries ran out. One product dominated the field, but we were surprised by the feisty performance of some of the more inexpensive machines.



Best Value

CRAFTSMAN 17428

RANKING: ★★★★★

PRICE: \$60
WEIGHT: 2.12 lb LAGS: 63
BATTERY TYPE AND SIZE
(AMP-HOURS): Li-ion/1.5 Ahr

LIKES: This tool represents cost-effective driving, especially for homeowners who already own other Nextec tools—Craftsman's highly successful cordless platform—and don't need to purchase a battery pack. It has one of the more responsive triggers in our test. Comfortable shape and balance make this an easy-handling tool.

DISLIKES: None.



DEWALT DCF815S2

RANKING: ★★★★★

PRICE: \$125
WEIGHT: 2.31 lb LAGS: 108
BATTERY TYPE AND SIZE
(AMP-HOURS): Li-ion/1.5 Ahr

LIKES: The most comfortable of the drivers has a slim, well-shaped handle that allows the user to quickly scoop it up. Its block-shaped battery means you can stand the tool upright, which is useful when working inside kitchen cabinets. Its nose-mounted worklight illuminates like a train in a tunnel.

DISLIKES: Should come with a carrying case, like almost every other tool in the test.



HITACHI WH10DFL

RANKING: ★★★★★

PRICE: \$110
WEIGHT: 2.19 lb LAGS: 64
BATTERY TYPE AND SIZE
(AMP-HOURS): Li-ion/1.5 Ahr

LIKES: A midrange performer with a smooth-running motor and sensitive trigger switch, the Hitachi sunk its lags without any hint of its feeling the strain.

DISLIKES: Not really a complaint as much as an observation: Hitachi's tools are considered pro-duty, but we think the next version will have to drive twice as many lags on a charge to maintain that reputation.



MASTER MECHANIC 147616

RANKING: ★★★★★

PRICE: \$80
WEIGHT: 2.16 lb LAGS: 53
BATTERY TYPE AND SIZE
(AMP-HOURS): Li-ion/1.3 Ahr

LIKES: Not a bad little tool. If you got one for a present, you'd be quite happy with it. Its performance is respectable, even if it wasn't among our top finishers.

DISLIKES: It looks a bit dated. It needs another trip through the design department to slim it down, and the engineers need to add some amp-hours to its battery to boost lag-driving performance.



Best Overall

MILWAUKEE 2453-20

RANKING: ★★★★★

PRICE: \$137
WEIGHT: 2.26 lb LAGS: 213
BATTERY TYPE AND SIZE
(AMP-HOURS): Li-ion/2 Ahr

LIKES: It's rare to see one tool punish the competition the way the Milwaukee did. Honestly, we were amazed. A brushless motor and stout drivetrain produce 1,200 inch-pounds of peak torque, so we never questioned its lag-driving ability. It's also easy to use, thanks to a two-speed selector switch and an out-standing push-to-lock chuck.

DISLIKES: None.



PORTER-CABLE PCL120IDC-2

RANKING: ★★★★★

PRICE: \$80
WEIGHT: 2.34 lb LAGS: 57
BATTERY TYPE AND SIZE
(AMP-HOURS): Li-ion/1.5 Ahr

LIKES: At this price even a small detail can give a tool an advantage. The Porter-Cable's 950 inch-pounds of torque put it well ahead of comparably priced products (at about 800 inch-pounds). That gives it an edge in speed and ease of driving. It also has a magnetic bit holder, a well-ventilated motor, and a decent belt clip.

DISLIKES: A small, petty gripe, but the handle is a tad thick.



RIDGID R82237

RANKING: ★★★★★

PRICE: \$120
WEIGHT: 2.45 lb LAGS: 83
BATTERY TYPE AND SIZE
(AMP-HOURS): Li-ion/1.5 Ahr

LIKES: The Ridgid proved to be our most fully featured driver. Certainly its lag numbers are respectable, but its torque output (1,100 inch-pounds) enables fast driving and the ability to handle large fasteners. We also like its push-to-lock chuck. It releases bits easily, ejecting them the way you'd shuck a spent shell from a shotgun.

DISLIKES: None.



ROCKWELL RK2515K2

RANKING: ★★★★★

PRICE: \$100
WEIGHT: 2.74 lb LAGS: 45
BATTERY TYPE AND SIZE
(AMP-HOURS): Li-ion/1.5 Ahr

LIKES: We hesitated to include this hybrid of a drill driver and an impact driver, but we were pleasantly surprised by its performance. The 21-position clutch and a four-position selector switch (driving, impact driving, and two drilling speeds) greatly increase its versatility.

DISLIKES: Its design makes it bulkier and somewhat heavier than similar products.

Wheelbarrow Flats, Old Tool Boxes, and Recurrent Mildew

Popular Mechanics' senior home editor can fix pretty much anything. Even that.

By Roy Berendsohn



I bought my dad a new toolbox for his birthday and swapped him for the metal one that he's had since I was a kid. I want to restore the old box to its former glory. Any advice?

The process is actually pretty simple. Paint won't stick to a dirty surface, so wipe the box with a clean cloth and mineral spirits, or, if it's really nasty, something powerful like Castrol Super Clean. Follow that with a damp cloth and wipe the box dry. Next, remove any rust with a drill and a 60- to 80-grit sanding disc. If that leaves swirl marks, hand-sand them away. Your primer should be a high-build type, like what

they use for auto repair. It's thicker and will do a better job of hiding scratches and filling small pits. After one to three coats, remove any imperfections with 1,000-grit sandpaper, then add a couple coats of hammer-finish spray paint on the outside of the box. For the lift-out tray, stick with red. That's just how it's always been.

If either of the latches is shot, you can find a replacement (called a draw bolt) at Rockler, a supplier of woodworking tools and materials, or at websites that sell leather craft supplies. Use steel blind rivets to attach the new latches

No matter what it's been through, an old metal toolbox is usually worth salvaging.



and your dad's old toolbox will be ready for the next generation.

Even though I clean the mildew from the bottom shelf of my lower kitchen cabinets, it always comes back. Why?

Mildew needs moisture, so if you find the source of the moisture, you'll stop the mildew. Look for things like condensation forming on a cold-water line (insulate the line), or a leaky drain or connection. It's also possible that moisture from the crawlspace or the basement is working its way up and condensing in the cabinet. If you have a crawlspace, cover its floor with 6-mil plastic sheets with their edges taped together for a continuous seal, and tape the sheets to the foundation wall. A damp basement is a much bigger problem. All you can do is look for and fix the usual suspects—leaky or plugged footing drains, and ground that slopes toward the foundation, not away from it.

Once you've stopped the moisture, kill every last bit of mildew by cleaning the cabinet and applying Zinsser's Mold Killing Primer on the shelf and walls, then add the final touch: a topcoat of low-odor latex paint.

Every time I go to use my wheelbarrow, the tire is flat. What am I doing wrong?

It's time for a flat-free wheelbarrow tire. The Marathon flat-free tire can be hit with an ax, drilled, lit on fire, or even cut with a reciprocating saw. And it still works. It can probably handle your backyard. ■

SEE THE FUTURE THROUGH THE EYES OF THE PAST!

THE AMAZING WEAPONS THAT NEVER WERE

For more than a century, scientific and military experts have imagined a world of weaponry that included death rays, robot spies in outer space, and dirigible mother ships holding dozens of planes. Some predictions were shockingly prescient; others hilariously wrong—and you'll find them all in this new book alongside the stunning original color art.

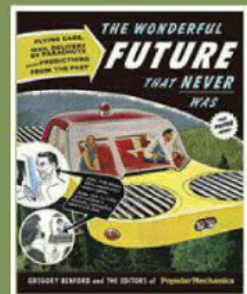
Edited by Nebula-award winning author Gregory Benford.



ALSO
AVAILABLE

"ALL THESE FANTASTICALLY FABULOUS FUTURES, AND I GET TO LIVE IN NONE OF THEM—AND NO, HAVING AN IPOD TOUCH DOES NOT MAKE UP FOR IT—BUT AT LEAST I HAVE THIS BOOK, WHICH ALMOST DOES."

—JOHN SCALZI, BESTSELLING AUTHOR OF
OLD MAN'S WAR



HEARST BOOKS

Available in hardcover or as an ebook wherever books are sold.

CROWDFUNDING GETS WEIRD

Strangers are giving strangers money for strange things at an alarming rate, and that might not be a good thing. **BY JOE BARGMANN**



FIVE BILLION DOLLARS.

That's the amount of money regular people had removed from their bank accounts and given to crowdfunding campaigns as of the end of 2013. Five b-b-billion, a \$3.5 billion increase from two years earlier. And what's amazing isn't just the raw number or the exponential upward trend. What's amazing about the evolution of crowdfunding—the process by which people ask strangers for money to help fund a project, but the strangers only have to pay if all the money is raised—is the asininity, dubiousness, and sometimes even fraudulence of some of the projects.

Let's take a look, shall we, at Esther the Wonder Pig, the poster beast of crowdfunding frivolity. Two Canadian guys adopted her a couple of years ago, thinking they were getting a mini pig. She ballooned to 533 pounds. They couldn't bear to lose her—she had led them to an epiphany about animal welfare or something—so they went vegan and launched an Indiegogo campaign to build a farm sanctuary for Esther and other would-be ham sandwiches. By July they had surpassed their \$375,000 funding goal.

Then there's Solar Roadways, an Idaho-based startup owned by Julie (a psychotherapist who breeds poodles) and Scott (an electrical engineer) Brusaw. Their idea: Lay down solar tiles like high-tech cobblestones to create walkways and driving surfaces that generate electricity and melt snow. Earlier this year the Brusaws sought \$1 million on Indiegogo and ended up with \$2,200,716. "We asked for \$1 million to hire an initial team of engineers to help us make a few needed tweaks in our product and streamline our process, [and] go from prototype to production," the Brusaws wrote. Never mind that a lot of experts have laughed the concept off the drawing board.

Kickstarter rules crowdfunding. As CEO Yancey Strickler says, "There's Kickstarter, and there's everyone else." Launched five years ago, it had landed \$1.2 billion by July 2014. The company takes a 5 percent cut if a project reaches its goal, and 42 percent of them do. Pretty good paycheck there. No wonder Strickler thinks every effort, even a bloated one like Solar Roadways, is worthy. "People are only going to back something if they believe in it," he says. As long as the crowd votes with its wallet, he contends, the market will grow. And he's stoked that Kickstarter has become a cultural force, declaring, "We get as many Google searches as Brad Pitt does."

Setting aside the ridiculousness of that statement, crowdfunding magnifies some interesting truths about Americans' spending. Emotion and impulse can thwart critical thinking. When something goes mainstream—as Esther the Wonder Pig did—and the crowd spends absurdly, others feel okay following suit. To wit, 239 people recently gave \$21,709 on Kickstarter to fund an artist's "hand-sculpted miniature Ice Age mammal set."

The site Your Kickstarter Sucks spoofs absurd projects, even though the guys behind it support crowdfunding. Cofounder Michael Hale cites the Reading Rainbow, a children's literacy effort that raised \$3.5 million beyond its \$1 million goal. "These kinds of projects are a force for good," Hale says. As for the other stuff? "We're not here to bully or attack people. But there is such an amazing wealth of bad content, and we are attempting to separate the wheat from the chaff. There is a lot of chaff. There is a metric shit-ton of chaff."

Posh \$375,000 digs for a quarter-ton pig in Canada? That money could have taught an awful lot of kids how to read. ■

New AMERICAN SUCCESS Stories



MATTHEW BURNETT
CEO / CO-FOUNDER

TANYA MENENDEZ
CO-FOUNDER

MAKER'S ROW



CHRYSLER IS PROUD TO CELEBRATE INDIVIDUALS WHO EMBODY THE NEW SPIRIT OF AMERICAN SUCCESS

Matthew Burnett and Tanya Menendez are what one might call entrepreneur's entrepreneurs. After dealing firsthand with the frustrations of overseas manufacturing, and seeing how all-consuming production on a hyperlocal level can be, the pair co-founded Maker's Row in Brooklyn in 2012, a site dedicated to matchmaking businesses with American manufacturers.

THE BIG IDEA: Leveraging their backgrounds in industrial design (Burnett, 29) and operations (Menendez, 26), they're making it easy for entrepreneurs to produce goods locally, via a simple six-step process that takes them from basic concept to final product. "We created this software to be the go-to solution for people to find, communicate, and manage their whole supply chain," says Burnett.

"Our definition of success is being to ensure we are meeting our goals, having a positive impact on society with our businesses, and making sure our businesses are growing."

MAKING IT HAPPEN: Their first focus was on the apparel space. "Manufacturers couldn't reach new clients. Clients couldn't find manufacturers. So the problem we were trying to solve was how to best connect them," says Burnett. Within the first two months of operation, they knew they were filling a need. "We realized we were having an impact when one of the first factories started hiring new workers to keep up with the increased demand," says Menendez.

LOCAL IS FASTER: "For a company's growth and ultimately success, it's important for entrepreneurs to be able to see and respond to trends," says Menendez. "The same thing that you can produce in a week in America takes three months overseas," says Burnett. "You can't beat the speed to market here."

KEEPING A LOOKOUT: As the company evolves, they are staying focused on creating solutions that will help brands build their businesses—including algorithms to make matchmaking more automated, easier, and faster. "It's no longer one-size-fits-all. It's solving a real problem for your own community," says Menendez.



Visit PopularMechanics.com/Chrysler200 or scan this page with the LAYAR app to see a video of Maker's Row and explore more inspirational stories.

We wanted to build a car that would change perceptions of what an American sedan could be. So we gave the All-New Chrysler 200 a class-exclusive **9-speed transmission¹** and a **Rotary E-shift**. A move that pushed gas mileage to an impressive **36 MPG HWY²** without sacrificing performance.

2015 model shown.



THE AVERAGE SEDAN HAS SIX SPEEDS.
WE DON'T MAKE AVERAGE.



CHRYSLER.COM/200

1) Excluding other Chrysler Group models. 2) EPA-est. 23 city/36 hwy on 4-cylinder models. AWD V6 model shown with EPA-est. 18 city/29 hwy. Results may vary. Chrysler is a registered trademark of Chrysler Group LLC.

THE ALL-NEW CHRYSLER 200



AMERICA'S IMPORT™

HOW TO MAKE ANYTHING



A RALLYING CRY: We live in an age of resurgent self-reliance. The only limit to our creativity is our determination, and that doesn't appear to be running out anytime soon. So consider this a call to action.

We hope the projects in this issue—some of which you could make in your basement today, some of which are being made by engineers and craftsmen around the country—stir in you an urgent desire to build something. Anything. It's what we humans do, after all. Plus, it's fun. All you need is a little guidance and some inspiration, which, with the help of many experts, we've provided in the massive special section that sprawls over the next 36 pages. Oh, and you might want a few tools too. And always wear safety goggles.



HOW TO
MAKE
ANYTHING



P. G. 75

PM

09.2014



HOW TO
MAKE
ANYTHING

PG. 76

PM

09.2014

HOW TO MAKE A KID*



Sekou Kromah has helped build 10 boats in the poorest section of the Bronx. Opposite: Tools in the shop at Rocking the Boat.

In the Bronx an after-school program teaches high school students to build wooden boats by hand. They learn a lot more than that.

By Michael Brendan Dougherty
Photographs by João Canziani

* WHO CAN MAKE A BOAT



THIS IS THE DAY THE STUDENTS HAVE BEEN WAITING FOR, AND IT'S PERFECT.

The sky over the Bronx is a clear, cool blue, with white sponge clouds drifting here and there. The traffic on the Bruckner Expressway, a massive eight-lane highway that chokes off this neighborhood from the rest of the borough and the rest of the world, is a dim wash in the distance, and the dark Bronx River ripples with expectation. In some neighborhoods of New York City—like this one—it's possible to live life without much awareness that this massive city grew up on one of the greatest natural ocean ports in all the world, and that it's laced with rivers besides. Many city kids don't even know how to swim, which makes what's going on here today all the more amazing. The students, these high school kids, are proud, but they try not to show it. They smile without showing their teeth, looking at the dirt. These kids built a boat here, in the Bronx, inside the brick walls of this shop, wood shavings falling like feathers to the plywood floors amid spattered drops of thick paint and marine varnish.

These kids built a boat.

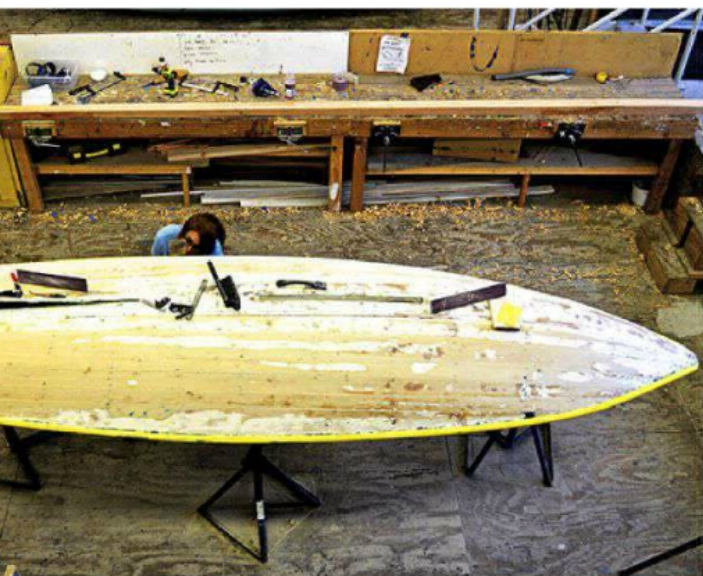
This is the semiannual launch at an after-school program called Rocking the Boat, an oasis of woodworking and engineering since 1998. The lot outside the shop is filled with people today, a crowd of probably 300. The



students are here, of course, and their instructors from the boatbuilding program, and the program administrators. Some alumni and their families. A few grinning local dignitaries, including a state senator. Neighbors, here to feel good for a day in a pocket of America in which one-third of the families subsist on less than \$15,000 a year. A band from the neighborhood—saxophone, trombone, tambourine, some kind of beautiful hand drum the size of a beach ball—plays music you can tap your foot to. Some of the families of the students are here, too, and the grandmothers and mothers and fathers, wearing their Saturday best, dance and sway. Over their heads, the towering cranes at the scrap yard next door swing and swivel, hulking clusters of metal dangling from their jaws.

The dock is maybe a hundred yards across the weedy rubble, in Riverside Park, a sliver of grass connecting the dead end of Lafayette Avenue to the river. Little kids—the siblings of the students, and kids from the neighborhood—scamper back and forth between the dock on the river and the party outside the shop, where everyone eats hot dogs and drinks sweet tea. One of the students, Gianmarco Bocchini—dark eyes, trim goatee, ropy arms—glides around the yard, a few girls following close after him and giggling. He rides the bus for a half hour each way to come build boats after school. Before this he had never built anything in the 17 years of his life. And then: “I drilled the holes. I painted it. I put my heart and soul into it.”

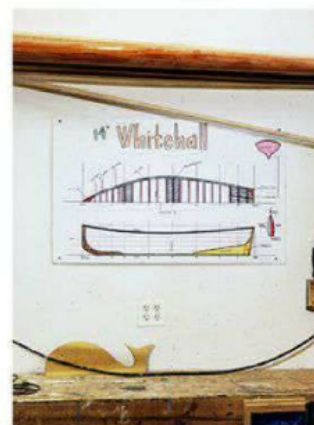
One of the full-time staff, Manny Roman, graduated a few years ago. He throws open the metal doors of a storage shed to show off a boat he built, *Snow*, a sleek white craft, the wood planks of its hull falling in neat slopes under the varnished gunwales. Manny wears Adidas cleats and baggy jeans flecked with paint, his sinewy arms festooned with tattoos, and his black hair pulled tight into a neat bun. There is pride in his eyes. He attended a technical high school, which should have fed his hunger for construction and engineering know-



When school lets out, students flood the Rocking the Boat shop in Hunt's Point (opposite). A student (left) refurbishes a Whitehall, a classic American design.

One of the boats built this year was named for Melissa Mulcare Boatswain, a former student who died last year. Her husband, Nigel (right), attended the launch. Hand-drawn plans for a Whitehall (below right).

Adam Green (below) founded Rocking the Boat in 1996. "I thought, okay, I officially got in way over my head," he says of the program's early years.



how, but he was way ahead of the other students, and the boredom was becoming destructive. So he found his way here. He says he wants to build a house for himself one day, like his grandfather did.

Two boats sit in the middle of the yard like sculptures in a garden. The *Boatswain* is a 14-foot Whitehall, a classic American design—a simple, tidy rowboat with a 4-foot beam and seats for four people. Whitehalls are the typical project for new students at Rocking the Boat. The *Boatswain* is an original work, built by hand, from scratch, these past few months, right here in the shop. The other, the *Fowl Play*, a 12-foot duck boat rigged for sailing, had been damaged in Hurricane Sandy, and the students in the program have worked to restore her strength and beauty. When it's time for the launch, the band collects in front of the boats and roars into "When the Saints Go Marching In." The students gather around each craft, watching one another for

cues, their faces serious and excited.
Here we go.



FOUR MILES NORTH of the brick-and-dirt headquarters of Rocking the Boat sits the Bronx High School of

Science, a prestigious, specialized public high school that counts among its graduates an impressive number of Nobel and Pulitzer prize winners. Just about every kid who graduates goes on to a four-year college, many to the Ivy League. Adam Green, straw-haired and earnest but with a rebellious streak running through him, enrolled at Bronx Science in 1987, one of the few New York City schoolchildren to be accepted among the 25,000 who apply each year. He hated it. He transferred to a private school and hated that too. He felt he was getting a curriculum, not an education. "This was the best society had to offer, and it didn't do much for me at all," he says. "I thought, screw this. I'm not going to do anything I don't want to do again." During college a teacher friend who worked with an environmental educational group asked Green if he would volunteer to help some students build a boat. It sounded like fun, and in doing it, Green noticed that the kids picked up some math skills in the designing and building of a boat, skills they hadn't gotten from textbooks or standardized tests.

In 1996, Green founded Rocking the Boat.

It was glorious. To Green, the program was an alternative school, his rebuke to a public-school system that fails the children who need it most in places like Hunts Point, which comes in 67th out of 69 New York neighborhoods in crime and safety, and where the child poverty rate is the highest in the United States. Many of the kids who showed up that first year didn't know how to use a ruler, let alone the principles of basic geometry required to make something like a boat. When asked what half of a half is, more than one answered,



"Three." Now Green was teaching them engineering skills, math, physics, woodworking, tool safety. But then something astonishing happened: Almost immediately, these kids started opening up to Green, telling him about their lives. There is some powerful alchemy in this transaction—of teaching and being taught—that can be transformative in the lives of both teacher and student. Especially in a place like Hunts Point. And Green soon realized that his modest after-school boat-building program might double as a form of therapy for these very poor, sometimes deeply troubled kids. This was wonderful in theory, but Green wasn't trained as a therapist. In the first year alone, three different girls told him on different occasions that they had been sexually abused by their mothers' boyfriends in their own homes. "I thought, okay, I officially got in way over my head," he says. Rocking the Boat soon hired its first social worker.



But craftsmanship was and has remained the primary focus. The Whitehall is a simple but not uncomplicated boat. The long planks that create the hull's skin are fastened to sturdy ribs spaced out every 6 inches from bow to stern. The shallow keel runs the length of the hull, extending into a slim skeg, a sort of fin sticking down into the water beneath the transom. Duck boats like the *Fowl Play* have a centerboard, a board stuck down through a slit in the center of the bottom of the boat once it's under way, steadying the craft the same way a keel does. The centerboard on the *Fowl Play* was badly damaged in Hurricane Sandy, and one student, Tito Columbie, 16, a Rocking the Boat apprentice (he graduated from the basic boatbuilding program and is now working with the instructors), undertook to repair it with a dutchman patch. He carefully cut away

the fragments of mahogany along the top edge, fit in a new section of wood, and screwed and glued the new piece on before fairing it into its hydrodynamic shape.

Long before they know how to dutchman a piece of shattered wood, the students—boys and girls—learn basic skills. First, they learn tool safety. They build their own toolboxes from white oak and cedar, the same wood the boats are made of—sides and bottom of cedar for strength, the rest out of oak. Building the boxes teaches them the properties of each kind of timber (oak is easier to drill than cedar), and they ease into skills such as nailing and measuring. They decorate their boxes however they like, and the row on the workroom shelf is a home-made hodgepodge of painted stripes and doodles, even a hand-drawn Transformers logo.

Soon they learn to make push sticks to keep their fingers away from the table-saw blade as they rip pieces of wood. They bend boards using heat and steam, then

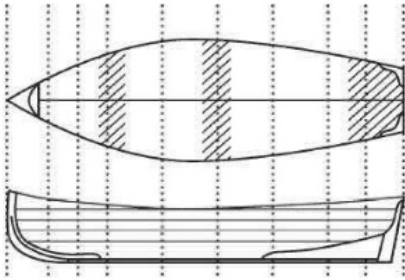
plane the planks, forming the smooth, deep bends of the Whitehall's shape. They learn lofting—deriving the hull's full-scale curves from a set of paper plans. They calculate angles, they measure twice and cut once, they apply paint and varnish with steady hands. They hammer nails, mix epoxy, apply clamps to joints while glue dries. They push hand planes carefully along the gunwales, crafting straight, splinterless edges. And slowly, afternoon by afternoon, they come out of their shells, these kids. They help other students they barely know, because that's what you do in a busy shop. They make friends, and begin to feel the astonishment one feels when something that didn't exist before takes shape from your own hand.

And slowly the boat starts to look like a boat.

The Whitehall goes back more than a hundred years in New York City—it was

once a common recreational rowboat, and before that, in the 1800s, swarmed New York Harbor, ferrying passengers and cargo from larger ships to shore. But in this tidy shop in the Bronx, they are tools to coax a sense of ownership and pride in a real achievement from nervous teenagers, some of whom have been taught to be tough, and some of whom have been taught that no matter how tough or smart or nice you are or how hard you work in school, it won't matter, because you will have nothing to show for it.

Above left, student Christian Colon on launch day, June 7, 2014. Above, the interior and oars of the *Boatswain*.



The Whitehall is a 14-foot craft with a wide beam and a shallow keel.



Clockwise from top left: The potluck barbecue before the launch; Aristedes "Tito" Columbie, as the *Fowl Play* reenters the Bronx River after a restoration (he repaired her shattered centerboard); 2014 grad Gianmarco Bocchini. "I drilled the holes," he says. "I painted. I put my heart and soul into it."

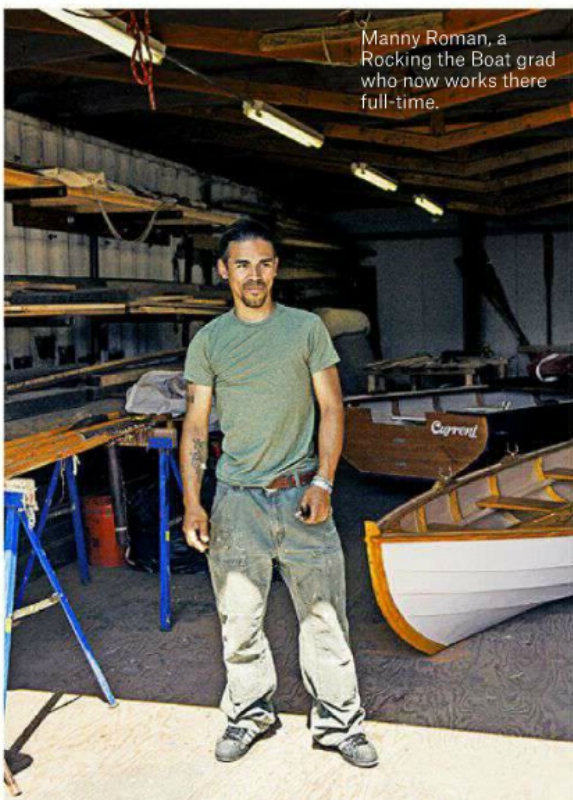
T THREE DAYS BEFORE THE LAUNCHES of the *Boatswain* and the *Fowl Play*, Rocking the Boat was a fever of activity. A dozen students flooded into the shop in the hour after school let out, barreling down the bright blue ramp that leads to the floor of the work area. This was the final week of Rocking the Boat's semester, and nobody needed much guidance at this point. They knew what to do. There was a stack of oars battered by years of powering Whitehalls up and down the river,

and a few kids grabbed the oars, balanced each one on an empty worktable, and began sanding them before a new coat of paint. Deeper in the shop, instructor Michael Grundman, 28, long-bodied and possessed of a good-humored patience with the kids, helped a girl remix a batch of epoxy to make it thinner, less peanut buttery in its consistency.

Edges were sanded, and the kids ran their hands over the boats' smooth lines. Over the past 13 weeks, their hands had learned how to discover the shape inside a piece of wood, and it was satisfying to feel it now. Paint was being applied—thick coats of glossy marine enamel. There was hardware to affix to both boats—deck cleats, bow rings. Tito Columbie checked his dutchman job on the centerboard. With the pads of his fingers he rubbed the seams that marked his work like a surgeon skimming a patient's disappearing scar. It looked perfect.

In the lobby, Sekou Kromah, a graduate of the program who now works at Rocking the Boat part-time, was refining his plans to become certified for contracting and construction work. He has comic-book biceps and a tree-trunk chest. Sekou and his three siblings fled with their mother from Guinea, a nation that was about to be swallowed by a violent political coup. Six months after emigrating, having landed in this forgotten corner of the Bronx, Sekou found his way into Rocking the Boat. He found Adam Green, and the instructors, and the social workers Green had hired. He found the C-clamps and the hand planes and the worn wooden mallets used to tap the Whitehall's wooden components into position on the frame. Sekou practices English in the shop. In a few days he will participate in the 10th launch of a boat he helped build.

"I'm not gonna lie, I'm a big homey" [Continued on page 116](#)



A Turkey Call



The slate-and-striker is the simplest turkey call to create, and very effective. Champion call maker Don Bald, of Lebanon, Illinois, starts by cutting a piece of slate (he uses chalkboard salvaged from a school wrecked by a tornado) with a band saw and smoothing out the edges with fine-grit sandpaper. The piece should be $\frac{1}{8}$ -inch thick and fit comfortably in the palm of your hand.

The striker consists of a handle and peg. Use oak or another hardwood for the peg. Bald turns his pegs on a lathe, making them just under $\frac{1}{2}$ inch in diameter at the top and gently tapered down to the tip, which he rounds off like the business end of a pool cue. All you need for the handle is a piece of dried corncob. Just drill a hole, place some epoxy and the striker in the hole, and test it out. The shorter the striker, the higher-pitched the sound, so give the slate a few strikes, adjusting the length of the peg below the handle until you get the pitch you want. Then let the epoxy set.

Before you use the call, rub both the slate and the striker with 280-grit sandpaper. It's like chalking the cue, and it'll give you a better sound.

How to Make

A Hole in the Ground

1. FOR A TOMATO SEEDLING

Use a shovel to loosen a foot-deep patch of soil, and mix in a handful of fertilizer. Work a hole into the dirt. Make it just deep enough that a couple inches of stem below the leaves remains above ground. **DIY**

2. TO SET A FENCE POST A clamshell digger and a digging bar work in any type of soil. Grip the handles of the digger, holding them together so that the metal jaws yawn. Drive the tool downward into the earth using your legs and core muscles for power. Pull the handles apart to scoop out the soil. Use the digging bar to clear rocks and roots. About one-third of the post's height should end up beneath the surface. **DIY**

3. FOR A BALLED-AND-BURLAPPED TREE

Turn a large patch of soil—three times as wide as the root ball—with a rototiller or a shovel. Start digging in the middle. The center should be the deepest spot, enough to bury the entire root ball, with the rest of the hole gradually sloping upward as it moves out and reaches ground level at the perimeter. **DIY**

4. THE DAKOTA FIRE PIT For this classic survival cooking unit, dig a vertical column 1 foot deep by 1 foot wide. Move 18 inches upwind and carve a 6 x 6-inch air vent diagonally to connect at the base of the larger hole. As the hot air escapes the main hole it draws fresh air through the other end of the tunnel. This constant cycle of air makes the fire hotter and saves on wood. **DIY**

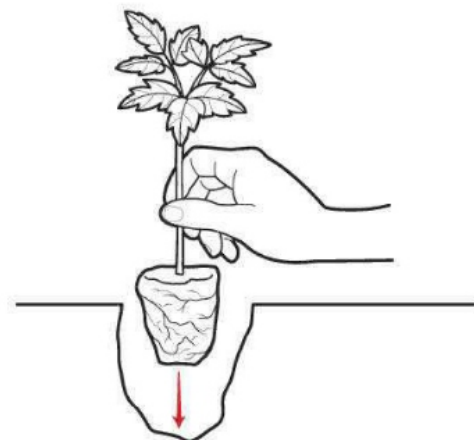
5. A GRAVE Mark your corners at 10 x 4 feet, and use a backhoe to dig 6½ to 7 feet down (this will accommodate a single casket—or two, one on top of the other). Climb into the hole to ensure that the bottom and walls are well-packed. Use a ladder, as you will want an exit strategy. Remove rocks, and cut away tree roots. This is someone's final resting place, so keep it neat.

NOT DIY, UNLESS YOU'RE A MOBSTER

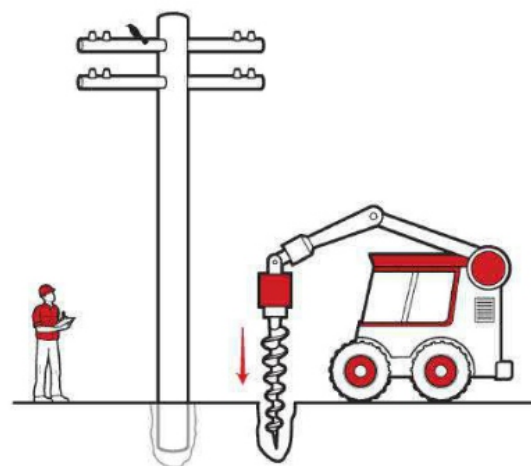
6. TELEPHONE POLE Use a truck-mounted 18-inch-diameter auger to drill a hole to a depth of 10 percent of the utility pole's length, plus 2 feet for good measure. With a small crane, lift the pole into place and steady it. Plumb it vertical and tamp with gravel and soil for stability. **ELECTRICAL-LINE WORKERS**

7. BACKYARD SWIMMING POOL

Leave the digging to the pros, but don't let them plan the pool for you. Rules of thumb: Pick a size that is proportional to the site. Avoid the trauma of family and friends opening your back door and



TOMATO SEEDLING



TELEPHONE POLE

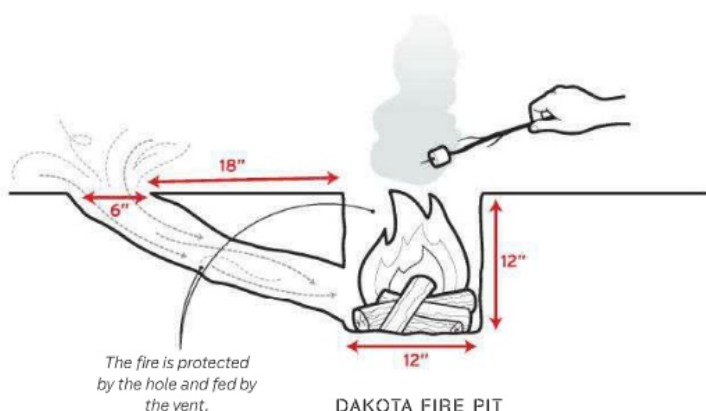
falling immediately into your swimming pool by ensuring that the square footage of the pool surround (decking, pavers) is adequate—it should be at least 5 feet wide.

CONTRACTOR

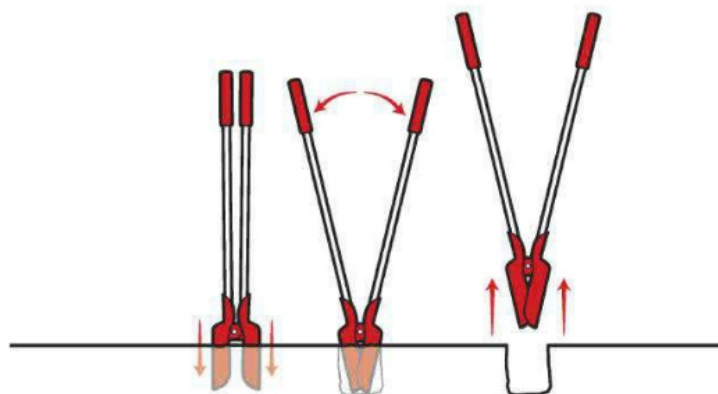
8. SURFACE COAL MINE Bulldoze and level the area to be mined, reserving the topsoil for the reclamation process after the mine is spent. Drill a series of small holes just above the coal seam. Pack the holes with a blasting agent such as ANFO (ammonium nitrate/fuel oil). Detonate. Using giant excavators, clear the debris to reveal the seam, and then start carving up your retirement fund. **SERIOUS DIGGERS**

9. NUCLEAR-WASTE BUNKER Find a remote location. Use a drill-and-blast method to create a tunnel that zigzags through solid granite to a depth of at least 1,300 feet. Seal the high-level waste in copper tubes, and lower into stone-walled shafts that are surrounded by a layer of bentonite—naturally occurring clay that expands and self-seals—then cap with ultradurable concrete. The bunker should last about 100,000 years, at which point the Martians or whoever else is left on our planet will have to figure out what to do with it. **THE GOVERNMENT**

—Theresa Breen



DAKOTA FIRE PIT



FENCE POST

Fried Chicken

By Mark Steuer, head chef of the Carriage House Chicago

Set up an assembly line around your stovetop. On one side, keep your raw chicken and three mixing bowls—the bigger, the better—ordered from dry ingredients to buttermilk to dry ingredients.

On the stove, set a cast-iron skillet. On the other side of the stove, set a cooling rack on a tray. Now you're ready to go to work.

- 1 pound all-purpose flour (about 3½ cups)
- 1 tsp cayenne
- 1 Tbsp each: chili powder, ground pepper, garlic powder, kosher salt, onion powder, and paprika
- canola oil
- 1 quart buttermilk
- 2 Tbsp hot sauce
- 1 kosher chicken, cut into 8 pieces (2 wings, 2 thighs,

2 legs, 2 breasts), rinsed in cold water and patted dry with paper towels

Add the canola oil to the skillet until it is about halfway up the sides and set over medium-high heat. Using a cooking thermometer, bring the oil to 350 degrees.

Mix the flour and dry spices, and divide it between two bowls.

In the third mixing bowl, combine buttermilk and hot sauce, and set it between the two that hold the dry ingredients.

Piece by piece, dredge the chicken in one flour mixture, submerge in the buttermilk, then coat it in the other flour mixture. Using tongs, place the legs and thighs into the oil. The chicken will cool the



oil down to 325 degrees. Watch the temperature and adjust heat as needed to keep it there. Fry on one side for 8 to 10 minutes, or until golden brown, then turn it to cook for another 8 to 10 minutes.

Remove the chicken and set it on the cooling rack, season with a sprinkle of kosher salt. Repeat with another batch, until all your chicken is cooked.

THE BEST THING I EVER MADE

Sharkskin Suit

Daniel Caudill

Creative director, Shinola

✱

In college I was the guy who was always overdressed for class. I loved the style and sophistication of wearing suits, and I arrived at school in a jacket and tie almost every day. Unfortunately, Bloomingdale's would not accept devotion as a form of payment, so I started making my own suits. One day in 1985 I found a pair of iridescent, greenish-black rayon curtains (circa 1972) tossed in a trash can. I reclaimed them, and sketched out a basic design. They turned out to be perfect for an exquisitely tailored sharkskin suit—Frank Sinatra by way of *Saturday Night Fever*. That glossy green suit lasted me more than 15 years.



HOW TO
MAKE
ANYTHING

PG. 84

PM

09.2014



A LITTLE INSPIRATION: Minimalist Lamp by Meriwether of Montana, \$145. Like it? You can win it. Post a photo of yourself on Instagram making something, using the How to Make Anything hashtag, #HTMAAsweeps. The user who posts our favorite shot will get the lamp. See [page 8](#) for rules.

PHOTOGRAPH BY PHILIP FRIEDMAN

A Lamp

Like horror-movie sequels or species of beetles, the potential varieties of lamps are nearly infinite. There are chandeliers that look like jellyfish, and sconces that look like bowler hats. If you can imagine something, assume someone has made it light up.

Your actual project is probably simpler—a wood box, a vase, an old kerosene lantern. What it is doesn't matter. What you do to it does. A high-quality lamp relies on its electrical structure.

Whatever you're converting, you'll need something hardy to support the bulb socket and the harp. "Don't just stick a cord in a bottle, wrap it with electrical tape, and try to make that work," says David Huter, custom lamp builder and owner of The Lampmaker in Louisville, Kentucky.

You can get anything you need at a good hardware store. The key is a sturdy piece of electrical tubing informally called the rod ($\frac{1}{8}$ -inch ips lamp pipe). You'll thread this

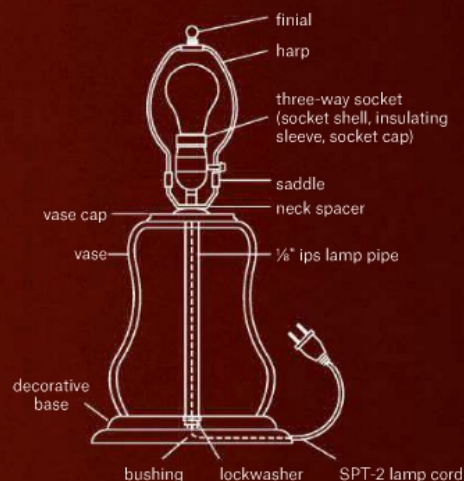
into the base of the lamp socket and then gently pull SPT-2 lamp cord through it.

Wire the lamp socket carefully. Separate the hot and neutral conductors in the cord by gently pulling them apart and tying them into an underwriter's knot. This prevents the conductors from being pulled loose from the socket's terminal screws if, say, your kid yanks on the plug.

The neutral wire has small ridges on the insulation, or a small white stripe. Strip the end of the wire and wrap its conductors clockwise around the socket's silver terminal screw. Tighten. Strip the lamp cord's hot wire, wrap it clockwise under the brass screw, and tighten. Complete the socket by adding its shell and insulating sleeve, and push the assembly into the base.

To finish the lamp, smooth any surface that can chafe the cord, or insert a plastic grommet in the lamp body and run the cord through that. This prevents abrasion and holds the cord firmly in position.

And there you have it. Your college bowling trophy reborn as a lamp. Your wife is still not going to let you keep it in the living room. *With thanks to lampstuff.com.*



Homemade Shaving Cream



$\frac{3}{4}$ cup shea butter



$\frac{3}{8}$ cup coconut oil—also great for cooking popcorn



$\frac{1}{4}$ cup olive oil



2 Tbsp baking soda

In a double boiler, melt together the shea butter, coconut oil, and olive oil. Feel free to add a few drops of an essential oil such as eucalyptus, which helps ease redness if you're prone to razor burn. Remove the mixture from the heat and let it harden in the fridge. Bring the compound back to room temperature, add the baking soda, and, using an electric mixer, whip it until it's the consistency of cake icing. Keep the shaving cream in a jar, and apply with a shaving brush. It won't lather like you're used to, but it's just as smooth. Plus, you made it.

A Plant Glow

A Free Throw

By Kevin Ollie, head coach, 2014 NCAA champion University of Connecticut Huskies men's basketball team



I owe Coach Jim Calhoun a lot. We run a practice drill I inherited from his staff in 2012. It's called the Nash Drill, after Steve Nash. When the guys are getting tired, we have them shoot rapid-fire from the free-throw line for 60 seconds. Make fewer than 17 and you run sprints. I believe that's what helped us shoot 87.8 percent during the tournament.

We also try to teach our players to find a routine and fall in love with it. Do the same thing time after time and there are no distractions. When I played for the Huskies in the early '90s, I would find the nail in the floor that lined up with the rim, and put my right foot on it. Then I would focus on the back of the rim, spin the ball once, and take the shot. Muscle memory is key. The great free-throw shooters are the ones who never stop working on it. Their mechanics are always the same.

Also, you've got to breathe right. A lot of guys get to the line and they hold their breath. I would breathe out, relax, and feel the tension leave my shoulders. I would envision the ball on its arc, funneling right over the front rim. Then, hopefully, that's exactly what happens.

W WHY WOULD YOU WANT TO MAKE A PLANT GLOW, you ask? To get attention. To beg the world to look at your strange and spectacular adventures in genetic modification, adventures that have nothing to do with ethically questionable food. To try to bring the tools and the wonders of synthetic biology into the mainstream.

Also, are you kidding? A glowing plant?

"Our vision is that people will be hacking together biological applications in the same way they are making mobile applications today," says Antony Evans, the CEO of a San Francisco company called Glowing Plant. (That is the actual name of the company: Glowing Plant.) The glowing *Arabidopsis*, a dainty flowering plant that emits a firefly-like light, is only a part of the company's plans to transform horticulture through genetic manipulation. You could make plants that smell especially nice, or filter toxic chemicals from the air. "Plants already do this, but maybe we can make them better at it," Evans says. A look at how he and his team made the *Arabidopsis* glow. — ALEXANDRA CHANG



STEP 1: Design DNA Sequences: Glowing Plant uses software called Genome Compiler to design DNA sequences based on a glowing gene (*lux operon*), found in a bioluminescent marine bacterium. The sequence also includes promoters, specific regions of DNA from the plant that force it to accept, then "express," the foreign gene—in other words, to show its new luminescence.

STEP 2: Print DNA: The team uploads the DNA sequence online and sends it to Cambrian Genomics, which laser-prints millions of strings of individual pieces of synthetic DNA. The result is white powder, which Cambrian Genomics ships in vials to Glowing Plant, via FedEx.

STEP 3: Test and Insert DNA: The team uses *Agrobacterium*—a special bacteria that can inject DNA into plants—to insert new DNA into a plant leaf. They test various combinations, and when they find one they're happy with—the brighter the better—it's off to the gene gun.

STEP 4: The Gene Gun: The gene gun shoots slivers of DNA-coated nanoparticle (made of tungsten or gold) into living plant stem cells. They revive the plant from the genetically modified stem cells, and harvest the seeds from there. Piece of cake.

STEP 5: Plant the Seed: Your standard plant-reproduction process.

MAKE IT YOURSELF: Glowing Plant is releasing a kit this fall that lets you make several plant species, such as tobacco and petunia, glow. It uses a floral dip process: You dip seeds into a solution containing the transformed *Agrobacterium*, allowing the custom DNA to enter the cell nucleus of the seeds. Then just plant, and wait. (Kits, \$300; plant seeds, \$40; pro-grown plant, \$100)

How to Make a Robot With a Kid

By Jenny Young, Brooklyn Robot Foundry



WHAT YOU NEED:
Battery pack (either two AAA or two AA)
Motor (130 size DC toy motor with wires)
Electrical tape
Button with thread holes
Glue gun
Makeshift robot body (tissue box, toilet paper roll, etc.)

1. Attach battery pack to motor (red wire to red wire, blue to black) and wrap exposed wires in electrical tape.
2. Slide the needle-like shaft of motor through a hole in the button and secure with a glob of glue.
3. Glue motor and battery pack to body.
4. Turn on.

◀ The Robot Foundry (brooklynrobotfoundry.com) holds classes to make the Tin Can Robot (left). It's easy to build, like the one Young describes here.



How to Make

Limoncello

BOOZE, LEMONS, SUGAR, AND TIME. That's all it takes to make limoncello, the bracing liqueur created in Italy and now catching on in other countries, including the U.S. "It's the perfect gateway DIY kitchen project," says chef Nate Anda, who concocts 14 variations of the after-dinner *digestivo* at his Washington, D.C., restaurant, The Partisan. His recipe for classic limoncello:

WHAT YOU'LL NEED

20 lemons
1¾ liters grain alcohol (or 100-proof vodka)
2 cups sugar

WHAT TO DO

1. Peel the lemons, using a sharp paring knife to remove all of the white pith from the inside of the peel. Toss the skins in a glass or plastic container large enough to hold at least 2½ liters.
2. Add the alcohol and seal the container. Wrap it in plastic and then aluminum foil (to shield it from light). Let the mixture sit in a cool place for two to four weeks (four is better), and then strain out the peels.
3. Make simple syrup by combining 2 cups water with 2 cups sugar in a saucepan and bringing the mixture to a boil, stirring frequently, for 2 to 3 minutes. Cool the simple syrup completely by placing the pan in an ice bath.
4. Stir 2½ cups of the simple syrup into the lemon-infused alcohol.
5. Divide the limoncello into bottles, seal, and let sit for a week to 10 days to let the syrup marry with the alcohol.
6. Serve very cold; limoncello is often stored in a freezer and presented in chilled glasses or small ceramic cups. — ELIZABETH GUNNISON DUNN

PHOTOGRAPHS BY PHILIP FRIEDMAN

How to Make Jeans

Crafting the perfect pair of pants has come a long way since stone-washing was used to soften denim in the '50s. Today's jean makers are applying high-tech methods to make sure you have never looked better. — ALEXIS SOBEL FITTS



Selvedge denim is made with stronger threads for denser, more durable jeans.

- A great pair of pants should hold up against the elements. Mason Industries, of Vancouver, British Columbia, coats its pants in fluorochemicals, creating water- and abrasion-resistant jeans—in case you want to go snowboarding in them.
- Denim brands like Rag & Bone and 7 For All Mankind exclusively are using lasers to bore in patterns that make their jeans look perfectly aged.
- After years of using synthetic dye, luxury-denim brand PRPS is incorporating natural indigo dye into its process. "It's less harmful when washed because it's a plant extract," says founder Donwan Harrell. And, like other revivalist brands, PRPS weaves denim on a selvedge shuttle loom—the finicky cast-iron machine widely used before the '60s. Because regular threads are so easily broken during weaving, selvedge denim uses stronger ones, making the fabric much denser.
- Pizarro, a Portugal-based denim laundry, is championing a more sustainable version of sandblasting: Its proprietary IceLight machine blasts pellets of dry ice at the denim. After the ice melts off, it leaves all the aging on the pants but none of the dust that's harmful to workers.
- Most brands use machines that produce seven to nine stitches per inch. At premium-denim brand 3x1, founder Scott Morrison insists on two individual rows of thread to make 11 to 13 stitches per inch. He also uses different-size pockets for each size pair of pants, so the seat (and you) looks perfectly proportioned.

THE BEST THING I EVER MADE

Linex the Robot

Lonnie Johnson

Inventor of the Super Soaker; dabbled in robotics in the early '60s; now creating a next-gen battery

✱

I built Linex in 1962, when I was at Williamson High in Mobile, Alabama. He was solar-powered and remote-controlled; he rolled around on wheels and could move his arms and hands like a person. He won me first place at a regional science fair—a pretty big deal for a high school kid. Robby the Robot, from *Forbidden Planet*, and the robot on *Lost in Space* inspired me to make him. Those robots were humanoid, and people inside of them animated their limbs. Linex moved only because of the mechanisms I built. He's not around anymore, though—I took him apart to build Linex 2. But he was ahead of his time. If I had continued to focus on projects like Linex, I guess I'd be the robotics king by now.



How to Make

Eggs

By Wylie Dufresne

SCRAMBLED

For years I scrambled eggs the traditional French way: low and slow. Stir, stir, stir. The result was loose, almost runny scrambled eggs with tiny curds (1). Over time I realized I liked a less runny but still creamy scramble—I wanted to cook the eggs longer but end up with the same texture. The solution was to add cheese at the end. I usually use Land O'Lakes American (it melts perfectly) (2), but any cheese will work. Then cream cheese is the final touch. It's the perfect smoother-outer because it's engineered to do that. It's not like it's aged in a cave in Philadelphia (3).

So, over to the stove. This process moves quickly, so get your ingredients lined up and your equipment ready:

- Deep saucepan with rounded sides
- Sauce whisk (not a big balloon whisk) (4)
- 2 or 3 eggs per person
- Salt and cayenne or white pepper (black pepper is too strong)
- 1 to 2 tsp unsalted butter per person

- Half a slice of cheese (preferably American) per person, torn into small pieces
- 1 Tbsp cream cheese per person

Crack the eggs into a bowl, season with the salt and cayenne, and whisk vigorously.

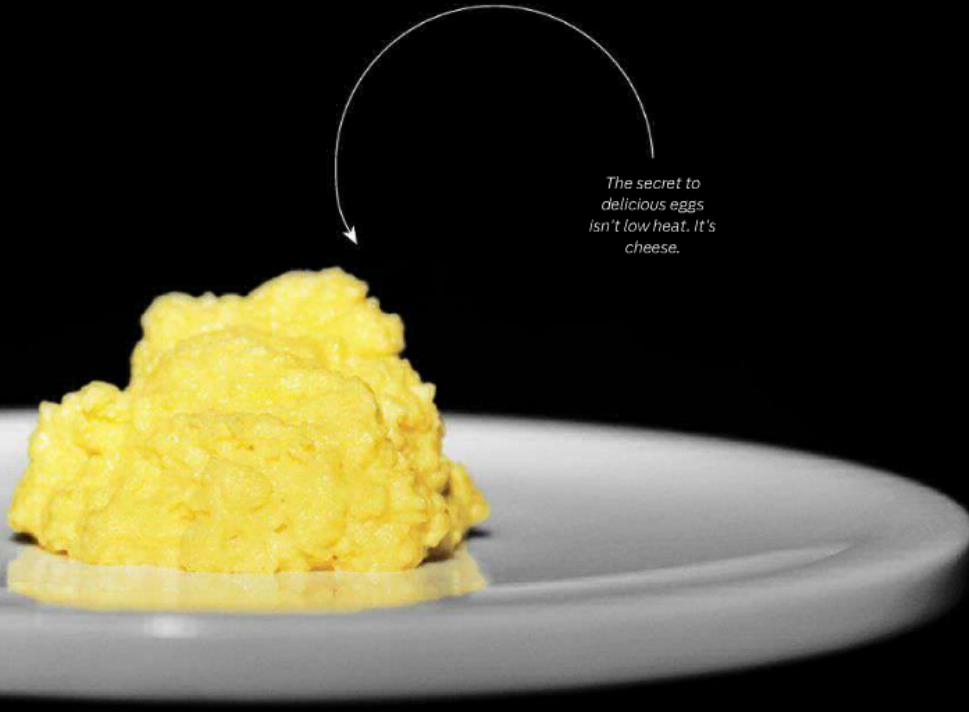
Heat the saucepan over medium-high heat, add the butter, and, once it foams (5), add the eggs. Whisk in a circular motion—the eggs should never stop moving. When the curds look almost dry (for 6 eggs or fewer, this will happen in less than a minute), remove the pan from the heat and add the cheeses, whisking constantly until they disappear into the eggs. That's it. Taste for seasoning, then serve, ideally with something crunchy. Sometimes I crush potato chips on top.

THE CHEF

Dufresne—mad genius behind the famed New York restaurant wd-50—is the kind of chef who reminds you why the guys in the kitchen wear white coats. A master of modernist cooking, Dufresne's food is like science that tastes extraordinary and delicious.

OMELETS

Even the most traditional chefs will tell you to use a nonstick pan for an omelet, because when you do it right, the eggs shouldn't stick or brown at all (6). I like a 10-



*The secret to
delicious eggs
isn't low heat. It's
cheese.*

inch pan for a three-egg omelet. Nonstick technology has come a long way, so if you're using the same pan you've had since college, get a new one. I'm impressed with the ones I've tried from Swiss Diamond.

Crack **three eggs** into a bowl and use a fork to whisk them well, then season with a little **salt and cayenne**. Over medium-high heat, add **1 tablespoon of butter** to the pan and wait for it to foam. Pour in the eggs. They will start scrambling, so you have to work fast—you're chasing fine curds here. With the fork, whisk using a vigorous flat, circular motion while shaking the pan back and forth. After the curds start forming, remove the pan from the heat, continue whisking and shaking for 10 seconds, then put the pan back on the stove for 10 more seconds. A fine, thin egg crepe is already forming on the bottom of the pan.

Remove the pan from the heat, angle the handle up toward your face, rest the far side of the pan on the stove, and tap the butt of the handle with your fist. The idea is to move most of the eggs to the front of the pan—you just want a thin layer up near you. Lay **a slice of American cheese** over that puddle of loose egg curds in the far side of the pan, then use your fork to gently fold the thin end of the egg over the

thick, cheese-filled end, tapping the pan on the counter to loosen the eggs. Invert the omelet seam-side down onto a plate. Ideally you have a pale yellow torpedo filled with runnyish eggs and American cheese. If not, practice: After a few hundred of them, you'll be ushering perfect omelets into the world.

OVER-EASY

Making an over-easy egg is actually not easy at all: You think, "I'll just flip these eggs, no problem." But then the yolk breaks, and you have to toss them (in a restaurant) or serve them looking like a mess (at home). Try this next time: Start with a nonstick pan. Get **a couple of tablespoons of butter** nice and foamy over medium heat and crack

in **two eggs**. Season them with **salt and a dash or two of cayenne**. I like to swirl and shake the pan regularly as the eggs cook, to keep them from sticking. After about a minute and a half the eggs should be sliding freely and the white should be pretty well cooked except for right around the yolks; that part should have started to gel. At this point you can flip the eggs. Don't try to do anything flashy. Grease a plate that's a little wider than the pan with **cooking spray or a smear of butter**. Slide the eggs onto the plate, invert the pan over the eggs, and, using a dry kitchen towel to hold the whole rig together, flip it over. Remove the plate, return the eggs to the stove, and cook them 10 or 15 seconds more—over, and easy.

1. In dairy, curds are the clumps you get when the proteins in milk denature. When you cook an egg, a similar thing happens: The heat causes the egg's proteins to change shape, and the egg firms up.
2. American cheese is created with vegetable oils, emulsifiers, salt, and more to be exceptionally stable and uniform, even when heated.
3. Cream cheese usually contains one or more of a trio of ingredients—xanthan gum, guar gum, and locust bean gum—that helps thicken and stabilize it. Works wonders on eggs.
4. The purpose of a whisk is to aerate ingredients as you stir. Different jobs call for different shapes. Sauce whisks incorporate less air, producing a smoother texture, and also fit the shape of the pan, so everything gets stirred and nothing gets scorched.
5. The foaming action is caused by water content boiling off. It means you're at a high enough temperature to cook with. Throw the eggs in while the temp is too low and they'll soak up the butter rather than cook in it.
6. The nonstick compound you've heard the most about is Teflon, which is based on polytetrafluoroethylene (PTFE), a chemical discovered just before World War II. Aside from being really slippery (it has a very low coefficient of friction), PTFE doesn't really react with anything—so it was used in the Manhattan Project as a pipe and valve coating.

How to Make

A Box

The box is the most elemental structure: Furniture is boxes with hardware. A house is a large, waterproof box. Once you can make a box, you can create far greater things. We asked three expert woodworkers to build a simple box to see how each would approach the task. Very differently, it turns out—despite giving them similar design briefs. The outside dimensions had to be 16 x 12 x 8 inches, and they could only use tools and materials found at their local home center. We ended up with three boxes with three distinctive joints, all equally awesome.

1

A Box Joint

By TED KILCOMMONS

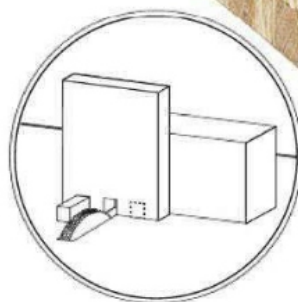
Kilcommons (tedkdesign.com) is a designer, builder, and teacher. He uses wood and other natural materials to bring warmth and texture to large-scale bar and restaurant projects in New York City.

Box joints are through joints that look a bit like dovetails, but you can mill them on a table saw. First you'll need to make a jig, which is a custom-made gadget for accurately making repetitive cuts. In this case, the jig helps you mill the box joint's pins and sockets to exactly the same size. Getting it right requires careful layout, so take your time and make accurate measurements.

The jig is basically a fence with a key and a notch that's attached to the table saw's sliding miter gauge. First, though, install a dado set on your saw to the width of your pins—my box has ½-inch pins, so I set up a ½-inch-wide stack—and raise the blade to the thickness of your box material. Hold the fence, which can be a piece of scrap, to the sliding miter gauge and cut a notch in it with the dado set. Move the fence over the exact width of the dado set, fasten it to the sliding miter gauge, and cut another notch. You now have a notch, a space (called a step-off), and another notch, each exactly ½ inch wide. Glue a ½-inch-wide key into the first notch so it extends a couple of inches from the fence.

Hold a side of your box vertically against the fence and tight to the key. Cut your first pin. Move the workpiece over, placing the socket you just cut over the key, and make another cut (see illustration). Continue across the workpiece. You can mill the adjoining side the same way, but you need to offset it so your first cut creates a socket rather than a pin. Take the piece you just cut and place it onto the key in reverse so its pin provides the offset needed. Then butt the adjoining side piece against it and make the first cut. Remove the offset piece and continue cutting along the width.

Spread glue onto the mating surfaces and clamp together, ensuring everything remains square. Once the glue has cured, clean up the joinery with a sharp low-angle plane or a palm sander.



Caution! Lay out the jig's key and notch accurately or you'll be burned by a multiplication of errors.



ILLUSTRATION BY HAISAM HUSSEIN

2

The Spline

By RICHARD ROMANSKI

Romanski studied fine woodworking and interior architecture at the Rhode Island School of Design. He and his wife run North Salem Design Group (nsdgstudio.com) in North Salem, New York, from a deconsecrated 19th-century church.

This box has plywood sides that attach to solid wood corner posts with thin splines. You can make this box as utilitarian or as upscale as you want, depending on the combination of materials you choose.

Chop the corner posts about an inch oversize—you'll trim them and the splines after you assemble the box. Mark the kerf, the slot into which the splines fit, on the end grain of a post. Mine were $\frac{1}{8}$ inch wide by $\frac{5}{16}$ inch tall—half the width of the spline. Use this layout to set up your table saw. Unless your blade is $\frac{1}{8}$ inch thick, you'll need to make multiple passes. Make the first pass on all four posts, adjust the saw's fence, and then make additional passes until the kerfs are formed. Repeat with the side pieces. Then rip splines from hardwood stock. To do this safely, use a push block. A push stick won't work here—the thin pieces will just rattle through. The splines should fit snugly in the kerfs but should also slide freely. Chop the splines about an inch oversize.

Spread glue into each kerf. Push the spline down into the kerf; if you slide it in from the end you'll squeeze the glue out. Tap the spline flush with the end of the post.



Trim the corner posts and splines on the table saw. Just make the cut, then carefully back out the box.



3

The Rabbet

By PAUL STEINER

Steiner is a career and technical education teacher at Woodbridge High School, Virginia. As a woodworker, carpenter, and handyman, he and his work have been featured on HGTV. He blogs at steinerwoodwork.com.

I used just a circular saw and a 12-inch rafter square to cut this box's housed joints. That meant cutting rabbets, which are two-sided channels, into the ends of two of the box's sides. I find this method of joinery perfectly acceptable for building cabinet carcasses or drawer boxes.

Set your saw blade's depth to the depth of the rabbet, which is usually half the material's thickness. Hold your rafter square with your free hand or clamp it to the workpiece, and use it as a guide to make the first cut the same distance from the edge as the thickness of your material. Move the square slightly toward the end of the board and make another cut. Repeat until you've removed most of the material, and then clean up the rabbet with a sharp chisel.

Spread glue onto the rabbets, and clamp the pieces together. Drill countersunk pilot holes and fasten with wood screws, keeping everything square.

For complete, step-by-step instructions on how to make all three boxes, go to popularmechanics.com/boxes.



Don't have a router with a rabbet bit? You can still cut a decent joint with a circular saw and a straightedge.



The lithium-ion batteries
powering our lives are
in need of major innovation—
or a full-on replacement.

But decades of research
have produced
few viable solutions.

Until now.

HOW TO MAKE BATTERY POWER MORE POWERFUL

By Erik Sofge Photographs by Matt Nager

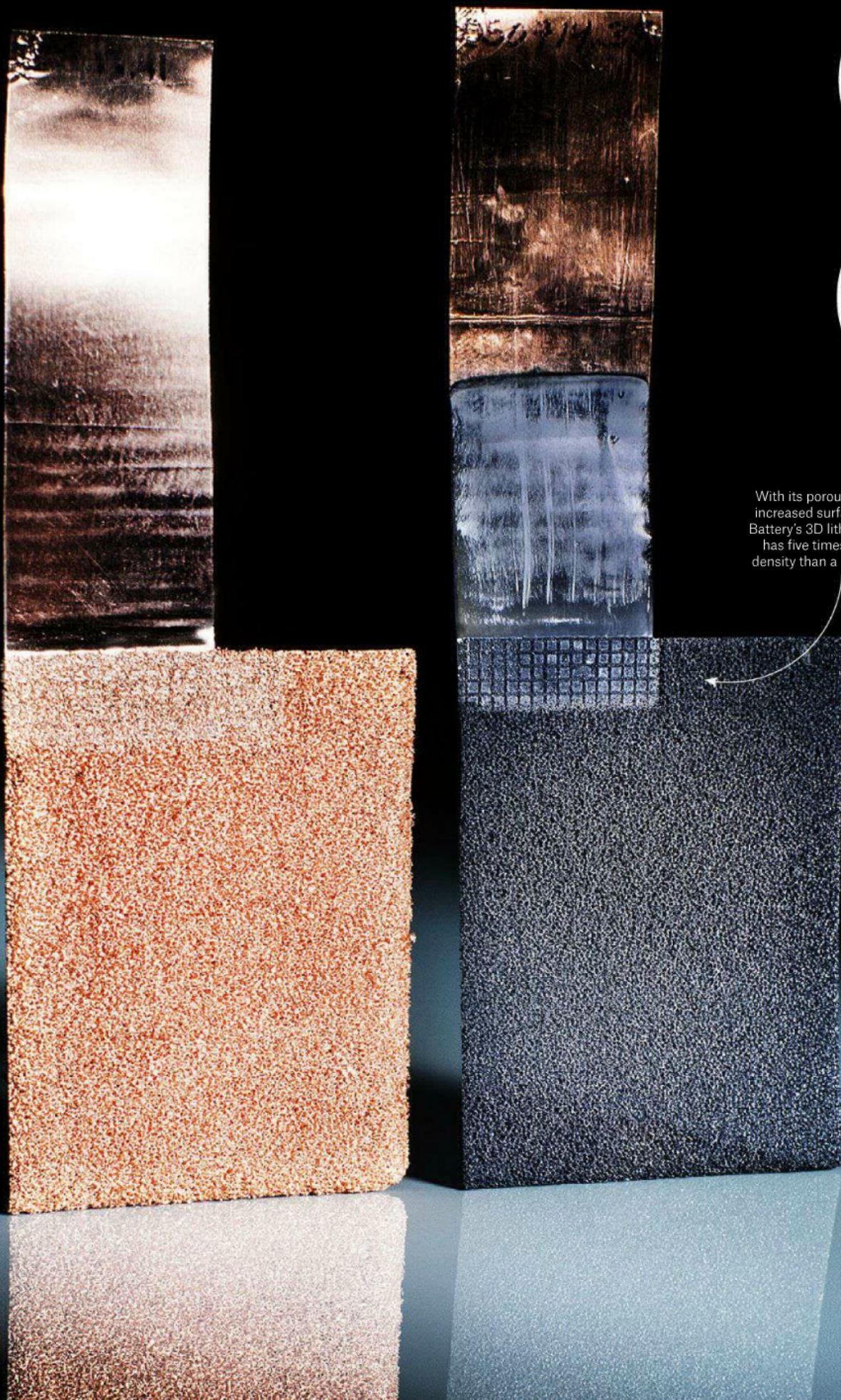
HOW TO
MAKE
ANYTHING

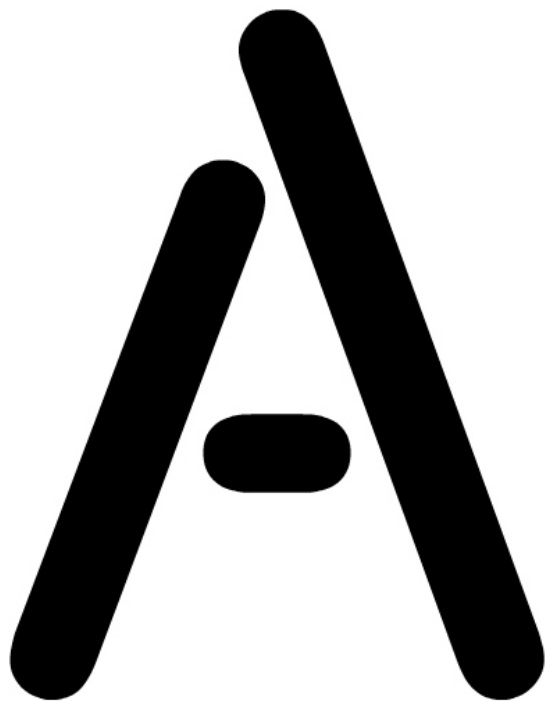
PG. 93

PM

09.2014

With its porous structure and increased surface area, Prieto Battery's 3D lithium-ion battery has five times more energy density than a standard Li-ion.





AT FIRST AMY PRIETO DIDN'T KNOW WHAT SHE WAS LOOKING at. The video on the laptop screen showed a pair of hands attaching a battery to an LED, which immediately lit up. This was in March of this year, and Prieto, a chemistry professor at Colorado State University and CEO and cofounder of Prieto Battery, was sitting in an Italian restaurant in northern Colorado. Derek Johnson, the company's other cofounder, sat beside her.

"He asked if we could meet somewhere on his way home, which was highly unusual," says Prieto, whose modest, soft-spoken demeanor seems unlikely for someone who runs her own company. She'd worked with Johnson for eight years, starting when he became her first post-doctoral fellow at CSU and then later the director of engineering and technology development at Prieto Battery, a nine-person company. Johnson runs the day-to-day research at the lab, overseeing the R&D of the company's next-generation battery that Prieto had first proposed in 2005. Typically, he'd email updates or call as they happened. Tonight was different. He wouldn't say why, but Johnson wanted to meet.

For all the suspense, this was hardly a secretive huddle in a darkened dive bar. They met at a place close to CSU and Prieto's house. Johnson drank iced tea, Prieto a ginger ale. Prieto's daughter—dad was out of town—ate ice cream. But Prieto had questions. She asked if the video was yet another test. Or maybe it showed a partial version of their battery powering an LED? She was baffled. And then it suddenly clicked for her. This wasn't a test. This was real.

PRIETO IS AT THE FOREFRONT OF ONE OF THE most important but least-talked-about technological frontiers. With their fast charging times and high energy density, lithium-ion batteries have revolutionized the way we live. They power our phones, tablets, laptops, and a growing number of electric and hybrid vehicles. They are seldom seen, but we are surrounded by them. And yet even as lithium-ion became the battery chemistry of choice in the '90s, scientists and

researchers were already searching for the next big thing in battery technology. Now, with rechargeable devices and electric cars proliferating, the push to find a superior replacement has only increased. But to understand why this is such a challenge, it first helps to know how a lithium-ion battery works.

Lithium-ion, or Li-ion, batteries rely on a delicate balance of power among four core components. The anode and cathode, called electrodes, push lithium ions toward one another across a small sea of conductive liquid electrolytes, releasing the electrons that power a connected device. The electrons flow in one direction when the battery is charging, and the other when it's discharging. Between the two electrodes is a separator, a perforated film soaked in the liquid electrolyte that only lets the ions through while keeping the anode and cathode from touching. If they do make contact, the entire system could short, heating up until the combustible electrolyte bursts into flames.

It's that bursting-into-flames part that has received a lot of attention in the past few years, with a rash of electric-vehicle fires and the occasional laptop blaze grabbing headlines. But the truth is that lithium-ion batteries rarely combust, and gas-powered cars are much more likely to end up as a crispy heap on the side of the road. Although battery fires are a legitimate concern, the impetus to innovate beyond Li-ion is based primarily on energy and the quest to pack more of it into smaller, cheaper spaces.

As recently as February the post-lithium-ion future of batteries could be summed up in two words: lithium-air. Often described as a battery that breathes, lithium-air batteries use the flow of air to release a huge amount of electrons, or energy, from the anode. This design cuts down on the weight and cost of the overall cell, which translates into vast improvements in energy density. Electric cars, for example, could go from a 100-mile range per charge to as much as 500 miles. And lithium-air seemed to be right around the corner. IBM's high-profile Battery 500 Project hoped to have commercial applications locked down before 2020.

But this past March the head of IBM's project backed away from lithium-air, citing high costs. By June the other major player in lithium-air was out too. The biggest problem was the purity of the O₂ being pulled into the cells, says Jeff Chamberlain, deputy director of development and demonstration at the Joint Center for Energy Storage Research. Any water, CO₂, or nitrogen could kill the battery and possibly even set it ablaze. The additional cost and complexity of building a suitable filtration system would dull lithium-air's edge over lithium-ion batteries, which continue to see slow but steady power improvements. "It's still better than today's lithium-ion, but at best equivalent with tomorrow's lithium-ion," Chamberlain says.

The rise and fall of lithium-air is indicative of the larger world of battery research: There's no shortage of scientific solutions that seem capable of dethroning





Prieto Battery cofounder Derek Johnson removes oil and impurities from the 3D battery's copper-foam substrate before the anode is electroplated on (above). During the production process, cells are hooked up to a machine that can gauge energy capacity, run life-cycle testing, and even mimic the energy usage of specific devices (right).

lithium-ion, but the road to commercialization is complicated. Despite filing its own alternative battery patent last year, electric carmaker Tesla Motors is developing what it calls a Gigafactory, a \$5 billion facility that will allow the company to build 500,000 Li-ion batteries a year. This might be the technology we're stuck with for decades to come—long after its energy capacity has been maxed out.

MAYBE THE MOST PROMISING THING ABOUT Prieto's battery is that it's still, in fact, a lithium-ion battery. But Prieto's design takes that precarious sandwich of two-dimensional layers—anode, separator, and cathode, with liquid electrolytes acting like an oozing condiment—and mashes it into a thicket of intertwined materials. The anodes and cathodes aren't separate components but, rather, two different coatings slathered on to the same Brillo-like copper mesh. Laying them on top of one another increases their total surface area and shortens the distance that electrons have to travel. Prieto calls this a three-dimen-

sional solid-state lithium-ion battery because its energy flows along all of those coated filaments, instead of swimming in a liquid in one direction or the other.

The potential benefits of Prieto's design are enormous. A phone or electric car with a 3D Li-ion battery could run as much as five times as long and fully recharge in minutes, rather than hours. And the foam-like cells can conform to virtually any shape before you add the final cathode coating, which fills the gaps in the copper mesh and sets the entire structure in place. So, along with the rectangular batteries found in many kinds of portable electronics, these cells could be purpose-built for space-constrained devices such as Google Glass.

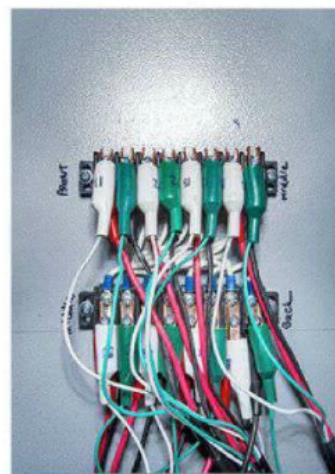
In addition to the huge increase in energy density, what also makes Prieto's design so revolutionary is that it doesn't blow up. In fact, the 3D battery is built to be nearly immune to the runaway thermal events that can occur in traditional Li-ion cells. That's because of another coating, which Prieto calls a polymer electrolyte. It's added to the mesh after the anode and before the cathode, conducting lithium ions between the two layers. This dry, nonflammable compound replaces Li-ion's biggest liabilities: the plastic separator film that can become punctured and the flammable liquid electrolytes that act as fuel for the resulting fires.

Neither Prieto nor Johnson will rule out the possibility of overheating, but they've held the 3D battery to an open flame. Nothing happened. "If you do that to a traditional lithium-ion battery," Johnson says, "I can guarantee you, it will catch fire."

IF PRIETO BATTERY'S 3D DESIGN MAKES IT TO mainstream production, griping about the limitations of lithium-ion will be all but obsolete. We'll be too busy fast-charging our devices and running them for longer stretches to notice that the underlying ebb and flow of ions hasn't really changed. But to see her battery succeed, Prieto is in the same race against the clock as every other startup.

It took four years for Prieto to

[Continued on page 116](#)



HOW A 3D BATTERY WORKS

Because of its nontraditional, mesh-like design, Prieto Battery's 3D battery has much more surface area than a typical lithium-ion battery. That means it can potentially hold up to five times more energy and can charge in a fraction of the time. Each battery starts out with a copper-foam substrate that gets layered with the main battery components (1).



First, the anode, which is made of the copper antimonide, is electroplated on to the substrate (2). The second layer, called the polymer electrolyte, keeps the anode and cathode layers from touching, which can cause shorts and fires (3). The polymer electrolyte also safely allows ions to travel between the anode and cathode. By using a solid-state electrolyte as

opposed to the standard yet highly flammable liquid electrolyte, the 3D battery is largely fireproof. The final cathode layer is applied in the form of a slurry (4) that covers everything and gives the battery structure when it sets (5). The battery's unique design also allows it to be shaped for odd spaces before the final cathode layer is applied.

How to Make

The World a Safer Place

As the science advisor for risk reduction at the U.S. Geological Survey, Lucy Jones is the expert on natural disaster preparation and response. She and Keith Porter, research professor at the University of Colorado, Boulder, have laid out a comprehensive government plan for what needs to be done the next time something really bad happens. What we can do to be ready:

SECURE YOUR SPACE

Live in a hurricane zone? Install storm shutters. Earthquake country? Attach your bookcases and cabinets to walls.

READ THOSE EMERGENCY TEXTS ON YOUR PHONE

Even a few seconds' warning can be enough time to pull over, seek shelter, or get out of an elevator.

BUILD BETTER STRUCTURES

The international building code doesn't require buildings to be usable after a disaster, but it'd be an economic boon if they were. Jones and Porter propose that many buildings could be made 50% stronger with only a 3% increase in initial construction cost.

PREP FOR THE RECOVERY

Reduced economic activity after a disaster can dwarf property losses. (New Orleans' annual gross domestic product is a projected \$15 billion less than what it would've been had Katrina not hit.) Communities that promoted local businesses before disasters struck have recovered more quickly. Shop local.

REVAMP INSURANCE

Insurance reimbursements are critical for reviving the regional economy. Jones and Porter suggest a national approach that would discourage development in high-risk regions and provide financial support to affected areas.

Then tell her that you need a table—not “looking for” or “wondering if we can get.” Need. If it can't happen for your desired time or party, fish for

HOW TO MAKE A DINNER RESERVATION // Be polite and appreciative but slightly prodding—authoritative without being a jerk. Any good reservationist will introduce herself when she answers the phone. You should do the same.

How to Make

A Chest of Drawers

Most people regard the thing that holds their socks and folded clothes as an object of utility. But the classic chest of drawers follows a fairly strict design formula that, when executed well, makes the finished product as handsome as it is useful. We asked Adam Rogers, the director of design and product development for Thos. Moser Cabinetmakers, to explain the basics. Even if you're not making one yourself, at least you'll know how to spot quality.

1. The top is minimally ornamented with a cove or ogee molding. It's attached with a sliding dovetail that is glued at the front of the case sides but not at the back. This allows some movement when changes in temperature and humidity cause the sides to expand and contract, so that the molding won't loosen nor the case crack.
2. The outer dimensions of the case correspond to a rectangle that presents the length and width in a 1:1.618 ratio. This is known as the golden rectangle, and it has guided architects and designers for thousands of years. It should be the starting point for creating a bureau.
3. Drawer depth declines by 1 inch—about the height of the divider separating each drawer—from bottom to top.
4. The case's corners are joined with through dovetails, an essential detail that puts the woodworker's skill on display.
5. As much as possible, drawer fronts are taken from the same piece of lumber to ensure continuity of color and grain. The drawers are joined with half-blind dovetails at the front and full dovetails at the back.



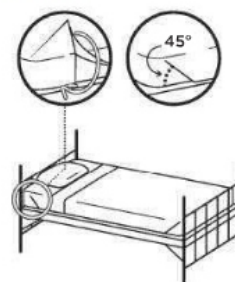
Your Bed

By Cadet Kyle Fredrickson,
West Point Class of 2015

Start by laying down a flat sheet and tucking 6 inches of it under the head of the mattress. Make hospital corners at the top of the bed, forming a tight fold at a 45-degree angle on each side (see right). Tuck in the sheet along the sides of the

mattress. Make it tight—no wrinkles. Leave the end of the sheet at the foot of the bed hanging free. Put on another sheet and a blanket (standard issue for cadets is gray wool), and make hospital corners with the three layers at the foot. Shove the sides of the top sheet and blanket under the mattress, and then fold back a foot-wide strip away from the headboard. When

you slide in after lights-out, it's like climbing into an envelope.



options. "I see. So, there's nothing at all we can do at 7:30 for four people?" Counter with your own alternative: "7:00 pm would be doable."

If they're fully booked, maybe next time don't wait until the day of.

How to Make

A Dumbwaiter

For those times you want to move something from the deck to the ground, and the stairs are just too far away.

Designed by Mark Clement, deck contractor and host of the radio program MyFixitUpLife on WCHE 1520 AM in Philadelphia and BlogTalkRadio.

A

At the midpoint of your deck railing, affix a post and pulley arm made out of an I-beam assembled from three 2 x 4s.

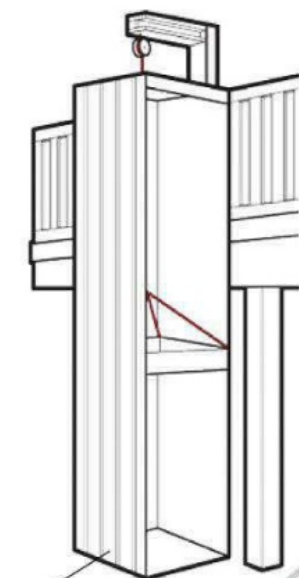
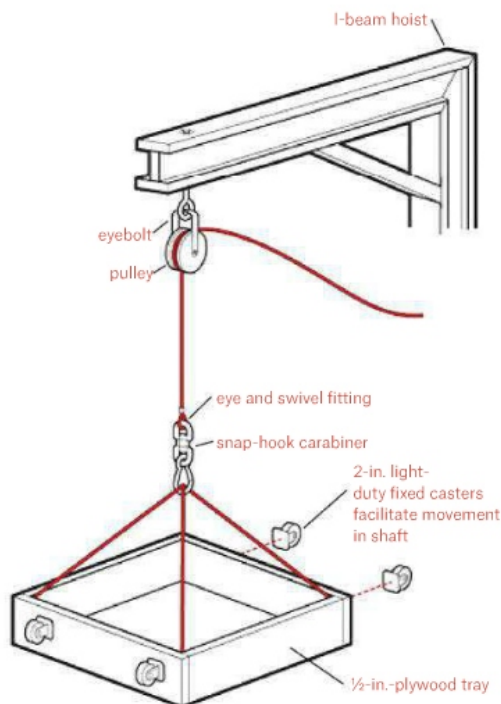
Where you join the post to the arm, miter it at a 45-degree angle for a nicer-looking, sturdier joint. Use weather-resistant structural screws for everything, and add an angle brace for strength.

Attach a 4-inch pulley to the arm using a large hot-dipped galvanized eyebolt. For the rope, pick something that will fit in the pulley with room to spare. A thinner rope will also be easier to tie off on the cleat you attach to the post.

In terms of the dumbwaiter's general design, you want the tray to be far enough from the deck to leave you room to build the shaft and a track for the tray, but not so far that you can't reach the tray comfortably. A good rule of thumb is to use half the width of the tray plus a couple of inches for clearance. The pulley arm should be high enough above the deck so that you can pull the tray toward you and over the railing.

Attach the tray to the rope with a shackle or a carabiner, and tie the rope to each corner using a bowline knot. The carabiner permits easy removal of the tray. (This is an important child-safety feature. Always remove the tray when the dumbwaiter is not in use to make sure that no one takes it for a joyride.)

Finally, build a frame out of pressure-treated 2 x 4s for the base of the dumbwaiter tracks and shaft. Note that the dumbwaiter shaft's height and width are dimensioned to suit the size of the tray and the height of your deck. The shaft itself is not structural; it just houses the dumbwaiter. In many cases it doesn't need to be built with 16-inch on-center framing or the same sort of rigidity you would use for building a house. (The exception to this is a tall shaft—say, 20 feet.) Extra framing is necessary to support tall shafts or those built in windy areas. In all cases the shaft framing needs to be rigidly attached to the deck framing using structural screws—and definitely painted or stained.



T1-11 plywood siding over wood framing forms dumbwaiter shaft

HOW TO
MAKE
ANYTHING

PG. 97

PM

09.2014

THE BEST THING I EVER MADE

Tree Nursery

Michael Van Valkenburgh

Landscape architect and designer of Chicago's new Bloomingdale Trail

*

I collected and oversaw the growth of a type of catalpa tree not found in the trade, so that I could use them in city-based projects where catalpa is valuable. I made my own material supply, in other words. Why are they valuable? Tough as shit. Pretty flowers.



A Topiary

Find the shape in the plant, don't impose one on it. If it wants to be a porpoise, help it be a porpoise. Cut when the leaves have turned dark and waxy (usually after July), then wait until the first freeze of the year to trim. Repeat for about five years to let the shape develop. And maybe find another hobby in the meantime.

With thanks to Tyler Diehl at Ladew Topiary Gardens in Monkton, Maryland.





How to Make

B - R



*This bread
contains only
four ingredients.
The recipe is 40
pages long.*





HOW TO
MAKE
ANYTHING

PG. 99

PM

09.2014

EAT - A - D :

Bread has nourished mankind for more than 30,000 years. It is the simplest thing you can eat, and yet the complexity of the biochemical reactions zinging through a ball of rising dough at any given moment is astonishing. **Andrew Sean Greer** bakes with his mother, a professor of food chemistry, and with Chad Robertson, a famous baker, to discover how bread—chewy, crusty, warm, comforting, everyday, miraculous bread—works.

Photographs by Eric Wolfinger



THE
STARTER

Chad's starter is better than mine. That much I can tell at a glance—a bubbling, luscious, fawn-colored batter. A starter is a baker's pride, grown from airborne yeast, flour, and water, carefully fed and tended over time, sometimes years. "We're going for yogurty," Chad Robertson, famous baker, tells me, shrugging. I smile appreciatively, not mentioning that mine, yesterday, seemed a defeated brown, smelling as sullen and sour as a teenager who has seen enough of life. A kind of goth starter. His is the homecoming queen.

Robertson is the co-owner of Tartine, the bakery and café in San Francisco. He is a star of the new wave of American baking, though he wouldn't put it that way. In his cookbooks and in person, he speaks of himself as someone merely curious about bread, the way someone else might be curious about wine or outboard motors. But many people are curious. Robertson is something different. Robertson is obsessed.

"Sorry I can't shake your hand," he says. It is 10:30 on a warm morning on Valencia Street, and he's carrying several basketfuls of dough that was shaped the night before and given its final overnight rise in the refrigerator. The mounds look soft and sweet, dappled with grain or flour, and as he walks each one shifts in

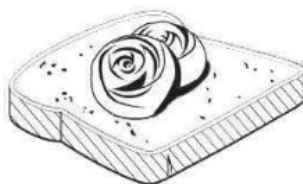
the basket like a sleeping baby.

Robertson is tall and has the strong-jawed face, ruddy build, and faded blue tattoos of a sailor, but he is almost delicate in the way he treats dough. Deliberate. He seems more artist than scientist. He is in sandals, pale-green jeans, a blue button-down, and a corduroy cap, and he gives off the calm of someone who has done this so many times he knows without thinking what he wants to see and smell. And what he wants to see and smell is not always the same.

When he's brought the dough into the kitchen and can at last shake hands, his are as large and enveloping as you would imagine a baker's to be—steady, working hands. My mother taught me to ask people about the

"Traditional, intuitive bread making does not lend itself naturally to a written recipe." — from *Tartine Bread*, by Chad Robertson (opposite).

How to Make a Butter Rose



A vegetable peeler and a glass tumbler are your tools. Flip the glass upside down and use the bottom as the platform on which you'll build the flower. Set out a stick of cold butter, and let it warm so that it is malleable but

still hard. Use your peeler to slice off a thin strip of butter, and roll it into a cylinder. Stand the cylinder up in the center of the glass. Peel off another strip, and wrap it loosely around the cylinder, letting the top edge curl

outward, like a real petal. Rotate the glass and keep adding slivers of butter, imperfectly and radiating out from the center. When you're satisfied with the size of the bloom, refrigerate it. Serve with good bread.



"Before the study of microbiology, bakers understood the subtleties of the process. The nature of fermentation was second nature to their own."

things they love. I ask about the dough.

"I'm not interested in going to the old country and bringing a tradition back intact," Robertson says as he holds a razor and begins to make cuts in the bread: long cuts in the country loaves, a square atop the rye. For a special porridge loaf, he snips along the top with shears. "This thing you hear with 'How old is your starter?'" He shakes his head. He is referring to the tradition of people handing down starters from generation to generation, as if a starter collects flavor and wisdom over time. "It doesn't matter." He's heard that Boudin, the famous old San Francisco bakery, flies its starter to Anaheim once a month so the branch down there can maintain its San Francisco essence. Robertson says he's made his bread from homemade starter in Mexico and in Europe and it tastes the same. To him the entire baking process is flexible. It isn't magic. You can do it this way, or you can do it another. As long as you understand the science, and as long as it tastes good to you.

Starter, leaven, dough, gluten, fermentation, steam, and temperature. Science.

I called my mother.

2

THE

LEAVEN



MY MOTHER IS A SOUTHERN lady with short dark hair and a wary, blue-eyed smile. She is also an experimental chemist and teaches a college course entitled *The Chemistry of Cooking*. I thought she would be delighted by my suggestion that, in preparation for baking with Chad Robertson, we bake a loaf of bread together.

"I am not a bread expert," she wrote in her brisk email reply. "But I have found you some references." Like most

scientists, my mother is unwilling to offer an opinion on something outside her area of expertise. But we bully our parents, we children, and so I arrived that morning with flour, bottled water, starter borrowed from a friend, and a recipe from *Cook's Illustrated*, the wonderful home-cooking magazine that explains the science and mechanics of recipes. Robertson's recipe in his book, *Tartine Bread*, is, somewhat famously, 40 pages long. The chapter on bread in my mother's classroom textbook (Harold McGee's *On Food and Cooking*) is 30 pages. *Cook's Illustrated's* 24-Hour Sourdough Bread is two.

"Hello, honey," she said when I arrived. "Do you want a hot dog?"

"We have to make the leaven first," I said. "Then it rises for 3 hours." The leaven is the stage between starter and dough, the prefermentation. The names for this stage can be confusing—it is called sponge, biga, poolish, or even starter—but the old French term is *levain*, translated as leaven. And this is the

Proteins must be plastic and elastic—capable of stretching around the carbon-dioxide gas produced by yeast, and resistant enough not to expand to the point of breaking. Proteins roll around chains of gluten, allowing them to slide past one another, providing the stretch of a good dough.

1

2

SALT DISSOLVES INTO
SODIUM AND CHLORINE,
ELECTRICALLY CHARGED
IONS THAT WANT TO BOND.
"THAT'S ALL HAPPENING
RIGHT NOW. IN THIS
DOUGH," MY MOM SAYS,
MANHANDLING IT.

term Robertson uses in his book.

"Bless your heart," she said, looking at my meek little starter. It is the kind of thing a Southern woman says with pity. She brought out a single sheet of lined yellow paper filled with chemical symbols.

"Mom, we have to make the leaven," I told her. "And then you can explain the chemistry to me."

"It's really biochemistry," she said. "Think of it like growing a plant to do what you want. I just wanted to explain about the electrical charges of salt dissolved in water . . ."

Growing a plant to do what you want. When I repeat this phrase to Robertson later, he says, "Yes, that's exactly right." (Although technically, yeast is a fungus, not a plant.) What yeast does is ferment. Robertson, in *Tartine Bread*, calls this "the soul of bread baking." Yeast is all around you, on your hands, on the grains of wheat—and a flour-and-water culture, left alone to sit for a few days, will begin to bubble with the activity of wild yeast. A consistent feeding schedule (more flour, more water) will produce a creature that does as you command, rising and falling on schedule, producing sweet, ripe fragrances after feeding, meaning it has the right blend of yeast and bacteria to produce delicious bread. This trained pet in your fridge, this genie, is your starter. A little of this starter, combined with flour and water and left to sit, is the leaven. A final addition of flour and water turns it into dough. What yeast does in all of these stages is perfectly simple: It

"The key to making good bread is not the oven—any oven that can store and radiate heat, and trap steam, will work. The eventual nature of the crust is largely determined before the loaf is ever baked."



grows. It does this by feeding on sugars and starches and converting them into ethanol and carbon dioxide. It ferments. By doing so, it creates the basic structure of what will become the bread.



THE

DOUGH



"WATER IS FUNNY," MY mother had said when we returned to mix the leaven with the water and flour, at last creating the dough. "Its structure makes it very attractive. Once you add the water, it latches on to everything. The proteins, the starches." That was what we did, in a stand mixer: added water to the foamy leaven and then, slowly, added the flour. It mixed for a minute, then rested for 20.

Flour has two kinds of protein: loosely coiled glutenin and more tightly coiled gliadin. It's the glutenin chains that end up linking end to end, aided by water's attractive properties, bonding into coils, and these adjacent coils, weakly attracted to each other, form the beginnings of gluten. That is why the dough must rest after mixing—a process named autolyse by the French breadmaking authority Raymond Calvel. It seemed utterly magical to me

that all this could happen simply with the addition of water: It was just sitting there, looking very dull in the bowl, and all the while skeins of gluten were knitting themselves together at the molecular level.

We added salt. Then came the kneading.

Stretching the dough is a crucial step. After forming their tangled chains, the gluten molecules must be arranged alongside each other, creating ribbons of protein to hold the escaping gas—this is the purpose of kneading or turning the dough. Robertson doesn't knead. Instead, he turns the dough at a later rest by pulling it up with wet fingers and folding it back on itself several times. His turning technique achieves the same end: directing the gluten and encouraging bonds. Proteins need to be both plastic and elastic, that is, both capable of stretching around the carbon-dioxide gas produced by the yeast, and resistant enough not to expand to the point of breaking. You need plenty of water to hydrate this much glutenin, as well as that elusive other protein: gliadin. The little gliadin bits roll around beside the long chains of glutenin, allowing them to slide past one another, providing the stretch of a good dough.

"And you know," my mother said, manhandling the dough like a masseuse, "salt dissolves almost immediately into sodium and chlorine, electrically charged ions, and they also want to bond with everything. That's all happening right now. In this dough."

Robertson agrees—he later tells me the only real disaster is if a baker forgets to add salt. Add it too early, before autolyse, and those little ions my mother talked about will start bonding and slow the creation of gluten. But when it's added later, the ions cluster around the gluten, preventing them from repelling each other, allowing more extensive bonds. If it's not added at all: The yeast will rise too quickly.

"I think that's enough, Mom."

She laughed because it was still a sticky mess, not the firm ball the recipe called for. But we placed the dough in a bowl and covered it with plastic wrap for the first rise, called the bulk fermentation. While the previous rests are focused on gluten formation, this rest is longer, about 3 to 5 hours.

Continued on page 120



How to Make a Sandwich

Starting with the bread, build the sandwich in your head first, balancing salt, acid, heat, and texture (between crunchy and soft). Take bologna, mayo, and white bread. You have spicy meat, rich sauce, and soft bread. Mixing acidic French's yellow mustard with the mayo balances the richness, and potato chips on the sandwich add crunch.

Fold and layer meat evenly across the bread. You don't want a hump of ingredients in the middle.

And use a sharp serrated knife to cut corner to corner on sliced bread for the best display. With a hard roll, cut the sandwich into pie-wedge-shaped thirds.

With thanks to Joshua Smith, owner, Moody's Delicatessen & Provisions, Waltham, Massachusetts.

"As you gain an understanding of how bread 'works,' you will be able to make adjustments in timing and technique to achieve a broad range of results."

THE BEST THING I EVER MADE

Haunted
Halloween Maze

Derik DeVecchio

Telescope designer,
Celestron

★

My brother and I have been building a haunted maze in his yard for the past five years. It's getting pretty big—last year 500 people showed up, and it took them an average of 10 minutes to get through. The zombie eating glowing green slime took some real work, but the maze itself is easy to build: Buy a bunch of commercial rebar and have it cut into 2-foot lengths. Hammer each spike into the ground about halfway, and slip a piece of electrical metallic tubing over it. Those spikes mark the path of your maze. After they're set up, use sheets of industrial-strength plastic fastened with binder clips to form the walls. It needs to be sturdy enough to stand up to a breeze and the occasional panicked trick-or-treater.



Hardwood Lump Charcoal

Those mass-market charcoal briquettes at your local grocery store provide a cheap, reliable flame, but they're also made from compressed, burned-up wood scraps ("char") and chemicals. That's fine for most people, but barbecue purists prefer the hot, all-natural burn of hardwood lump charcoal. It's made by burning wood in a furnace with very little oxygen—inside a ceramic grill like the Big Green Egg or a cast-iron smoker. The smoldering cooks off all the water and impurities, leaving you with the wood's fuel-rich carbon core. Sure, you can buy it, but you can also go buy your steak at Outback. Here, Adam Perry Lang, a classically trained chef and unparalleled BBQ innovator, shares his method for making lump charcoal at home.

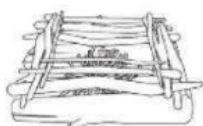
1. **BUY OAK, HICKORY, MESQUITE, APPLE, OR PEACH HARDWOOD**; cut into softball-size chunks. Wood sellers, such as Hawgeyes BBQ (hawgeyesbbq.com), take orders online and deliver by mail.
2. **SET UP YOUR FURNACE ON A HEAT-RESISTANT SURFACE**—your driveway, for instance—well away from your home, car, or anything else you don't want to melt or burn down. You'll probably want a fire extinguisher nearby.
3. **LOAD THE FURNACE THREE-QUARTERS FULL WITH WOOD**. Intersperse balled-up newspaper and paraffin-wax starters to help get the fire going.
4. **LIGHT THE FIRE**.
5. **CLOSE EVERYTHING UP**, leaving a small air vent to allow steam and smoke to escape. The fire should be smoldering, smoky, and very, very hot. It should also be left alone. Don't even crack the lid.
6. **ONCE THE FURNACE IS COOL TO THE TOUCH (ABOUT 12 HOURS LATER), OPEN IT**. The charcoal pieces should be around the same size as the wood chunks you began with. Just be sure that the fire is completely extinguished and the charcoal is cool before sticking your hand in there to pull anything out.

— ELIZABETH GUNNISON DUNN

A Campfire Two Boy Scout-approved methods.

THE LOG CABIN

GOOD FOR: Campfire cooking, slow-burning fires.



HOW TO: Lay your wood crisscross in a square, the way you did with Lincoln Logs as a kid, around your tinder and kindling. Use larger pieces of wood as the base, and work up from there, with the smallest pieces at the top.

THE TEPEE

GOOD FOR: Hot fires, windy conditions.



HOW TO: Stand up three or four big sticks so they form a point over your bundle of kindling. They act as a chimney, drawing air in. Then add your larger logs in the same shape around the existing structure for support.

HOW TO
MAKE
ANYTHING

PG. 105

PM

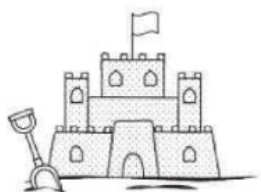
09.2014

Lump charcoal burns
hotter than briquettes and has
none of the chemicals.

A Sand Castle for a Kid

Dig out a trench from the shore to your building site, providing you with a continuous supply of water and a built-in moat. Tamp down a mound of moist sand in the rough shape of your castle. (A four-corner fort is easy for kids.) In a large bucket mix sand with enough water that a layer of water rests on top. Pull out

handfuls of the wet sand and pack them into pancakes. Press the pancakes onto the sides and top of



the mound to build up the main castle, pounding the sand with your palm to force water out and solidify the structure. Work around the perimeter, from the bottom up, smoothing out the sides and shaping the castle as you go.

To add towers, put an upside-down beach bucket with the bottom cut off

in the place you want the tower. Fill it with the sand-water mixture, let it set, and lift off. Use a straw or fork, whatever you have lying around, to draw details such as bricks onto the smooth surface of the castle.

With thanks to Marianne van den Broek of Sandisle Sand Sculptures, Key West, Florida.

An Edge

By Tim Heffernan

>

THE EXPERT: Adriaan Gerber, bladesmith

THE EQUIPMENT: Combination waterstone with a grit of 1000/4000, and an 8-inch, single-cut flat metal file in a fine grade.

THE GENERAL RULE: Work standing up so that you can use your body, not your arms, to slide the blade. With elbows pinned at your sides, rock your body back and forth with each stroke to maintain a steady sharpening angle.

CHISELS, PLANES, AND OTHER SINGLE-BEVEL BLADES

If the back of the blade is scratched or pitted, run it in small circles on the coarse stone (1), then rinse and repeat with the fine stone. Otherwise, press the bevel crosswise against the coarse stone with one hand, supporting the rear of the blade with the other. Slide the bevel up the length of the stone and back again (2). When you've reached the desired angle, rinse, then repeat with the fine stone. Flip the blade and stroke the backside once or twice against the fine stone to remove any burrs that may have formed.



KNIVES, CLEAVERS, AND OTHER DOUBLE-BEVEL BLADES

Unless you're forming a brand-new edge on a dull blade, the fine stone will suffice for most sharpening. Beginning at the tip, push the blade up the length of the stone and draw it back. Move the blade over a quarter of an inch and repeat (1). Continue until you reach the heel, then flip the blade (2) and repeat with the other side.



AXES, MAULS, AND EVERYTHING ELSE

For draw filing, put down the stone and grab your file. Clamp the blade horizontally against your workbench, with a block of wood beneath it to elevate the edge above the bench top. Grasp the file at both ends, and place it across the far end of the blade at a 30-degree angle. Press down firmly, and draw the file smoothly toward your belly, following the blade's curve but keeping the angle steady. Without lifting the file, lighten the pressure and push it back to the starting position. Repeat until you have a flat, polished edge along the entire blade. Flip the blade over and repeat.



A Hit Song

When Black Keys guitarist Dan Auerbach writes a song, he's not chasing airplay. "I don't write for the radio. To me it's more important how the song will sound live," he says. Still, he's an ace at making gold records (the Keys' "Tighten Up," "Gold On The Ceiling," "Lonely Boy," and "Fever"), which is why he's in demand as a producer (notably, for Ray LaMontagne and Lana Del Rey). His technical tools are modest: He uses his iPhone to write lyrics and record snippets of vocals and riffs. He usually brings the elements together with a pro-level Radar recording system, but he sometimes uses Pro Tools software, which he recommends for budding songwriters. On the Keys' new album, *Turn Blue*, Auerbach and drummer Patrick Carney relied on their notoriously spontaneous recording style. "You have to find your own process," Auerbach says. "Just don't plan anything. Stephen Hawking doesn't need to come up with a blueprint for you." — Matt Hendrickson

PHOTOGRAPHS BY BEN GOLDSTEIN (KNIFE), ALYSSE GAFKJEN (AUERBACH)

How to Make

NASA Cool Again

A At some point between the *Challenger* explosion in 1986 and the end of the manned shuttle program in 2011, NASA became uncool. Once regarded as the wild geniuses leading us bravely into the future, the agency earned a reputation as insular, wasteful, and out of touch.

Naturally, they're looking to change that perception. The agency recently expanded its use of challenges and crowdsourcing to include more opportunities for regular Joes (citizen scientists, if you can bear the term) to submit their ideas. In 2012, it also hired Jenn Gustetic, a vivacious woman with an aerospace engineering degree and a master's in technology policy from MIT, to engage the public as the first-ever Challenges and Prizes program executive.

In this role, Gustetic, 32, uses her brains, charm, and wicked networking skills to increase grassroots participation in NASA's far-ranging mission. In the process, she's breaking down the wall that once separated a massive bureaucracy from the people it was supposed to serve. "It's my role to engage the public and put together nontraditional alliances to solve tough technology problems," she says. "NASA is opening itself up. We're inviting the public to be a meaningful participant in our business, our projects. This wasn't the way things were done, but it's the norm now."

One little problem Gustetic is helping to solve is the threat of an asteroid impact, which NASA has deemed worthy of intensive study as part of a larger initiative that includes not only redirecting space rocks but also sending humans to study them. The Asteroid Data Hunter contest, which wrapped in August, offered awards of up to \$35,000 to individuals who advance the development of algorithms to identify asteroids in imagery from ground-based telescopes.

Another of Gustetic's responsibilities is to rally teams for NASA's International Space Apps Challenge. This year, more than 8,000 people in 95 cities took part in the third annual two-day hackathon to develop tech related to deep-space exploration, manned missions, rovers and more. "It was a historic collaboration between a government and the public," says Mike Caprio, cofounder of Space Apps NYC, the main stage of this year's event. Teams of technologists of every stripe, from computer programmers to physicists, arrived at universities and labs all over the world to compete. After a long weekend, a few left with impressive CV fodder. The rest left impressed with their host.



Actual astronaut glove.

HOW TO
MAKE
ANYTHING

P G . 107

PM

09.2014



Revolutionary XADO



Patented Component. For more information contact 888-787-XADO (9236), to purchase visit your local retailers or www.xado.us

XADO Atomic Oils with Revitalizant®

- Extend the engine service life
- Maintain friction surfaces in a perfect state
- Reduce fuel consumption
- Dampen extreme loads
- Reduce noise and vibrations
- Protect the engine during cold starts
- Compensate parts' current wear

AUGUST

HOT DEAL

10%
DISCOUNT

Only through August, 1 – September, 1 2014

Get 10% OFF and FREE shipping on each online purchase of XADO Atomic Oils at www.xado.us

Full line of XADO motor oils, gear oils and ATF is subject for discount and free shipping

FREE SHIPPING

ATOMIC OILS with Nanotechnology

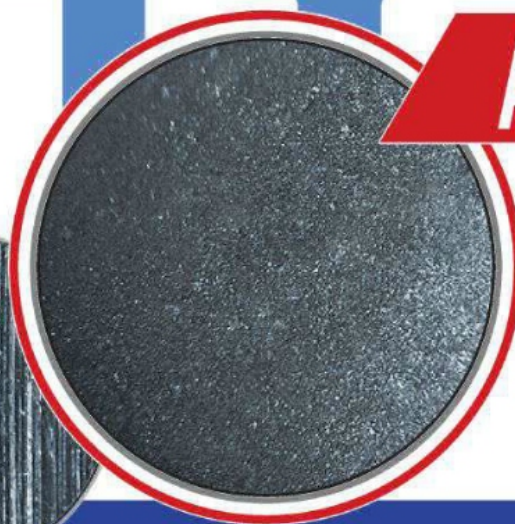
WHY?

BEFORE

Numerous scorings can be seen on the surface



AFTER



Smooth, glossy surface free of defects. No traces of scorings are left! Ceramic-metal coating restores the cylinder's worn surfaces & reliably protects the engine parts from future wear

The compression, power, efficiency of the engine will always be maintained at the highest level due to action of the patented formula of atomic Revitalizant® contained in XADO Atomic Oils. It coats friction parts with a diamond-hard ceramic-metal layer thus repairing and protecting them from future wear!



For dreamers
who do.



Live, learn, and work
with a community overseas.
Be a Volunteer.

peacecorps.gov

PROJECT

About \$30 in materials and a couple of power tools are all you need to build this stylish—and comfy—American classic.

Tools and Supplies: Circular saw / rafter square / bar clamps / cordless drill / two 1" x 10" x 10' boards of cedar or other weather-resistant lumber / 48 1½-inch exterior-grade wood screws

THE TWO-BOARD BACKYARD LOUNGER

One afternoon of work, one great chair.

By David Agrell

Okay, we'll admit that although last month's CNC-milled chair was awesome ("Create Your Own Flat-Pack Chair," July/August), the project was out of reach for many readers. So here's something you can build that doesn't require access to a \$25,000 CNC machine. In fact, you'll need little more than a circular saw and a cordless drill.

My design is based on the rustic-but-comfy Westport plank chair, which evolved into today's Adirondack chair. Thomas Lee built the original in 1903 while on vacation in Westport, New York, in the Adirondack Park. Legend has it Lee used a single board from a pine tree he felled on his property. It must have been a big slab; most Westport plans require around four



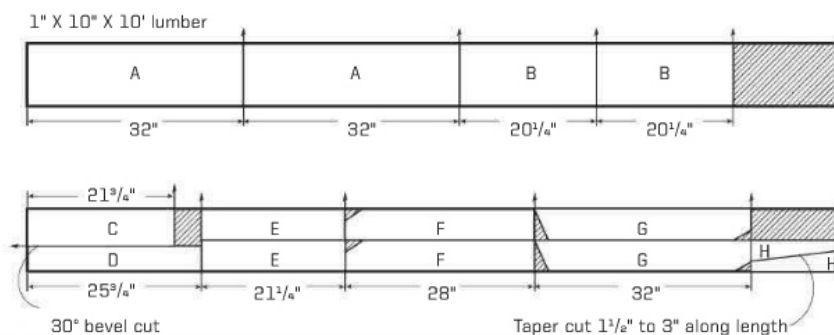
10-inch-wide boards. But in keeping with the spirit of the legend, you can build this chair with just two 1-inch x 10-inch x 10-foot pieces of lumber. It should take you a couple of hours—which is how long our CNC-milled chair took. So, man versus machine? It's a tie.

MILL THE PARTS

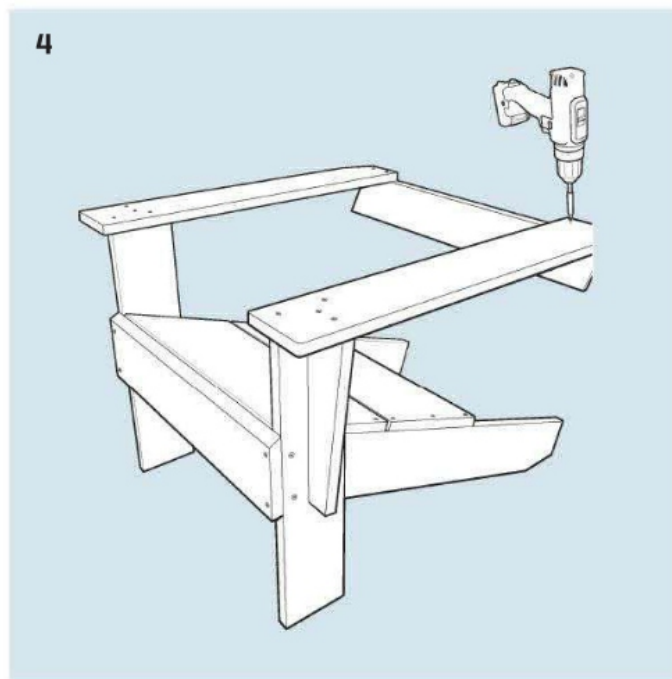
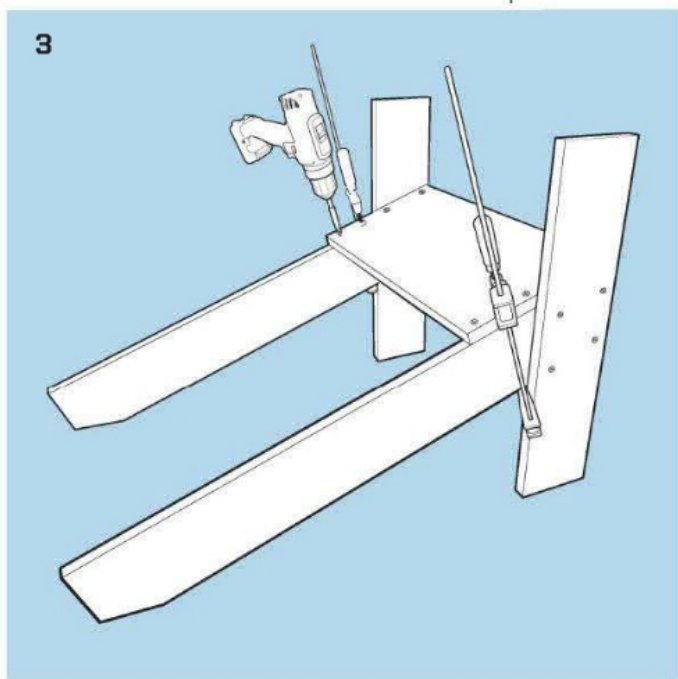
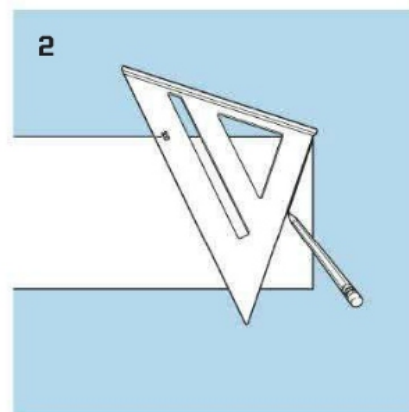
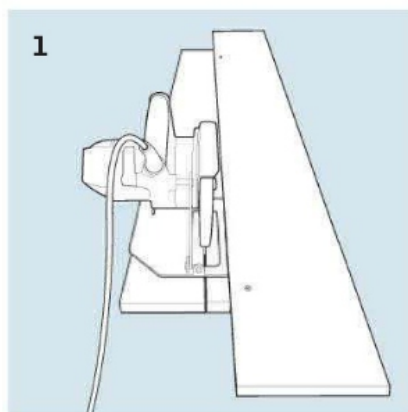
As with most furniture projects, first cut out all the parts from the lumber. You'll then build subassemblies that combine to create the chair.

To make the narrower parts, it's more efficient to rip the entire board in one pass and then chop the pieces to length. But before you do, cut off a full-width piece measuring 25 $\frac{3}{4}$ inches. This isn't ripped in half; more on that later.

Rip the remaining piece down the middle so you're left with two boards a little under 4 $\frac{7}{8}$ inches wide. To keep your cut line straight, use the other 10-foot board as a guide. Position this guide on top of the board so your saw's base plate runs along the guide's edge but the blade cuts through the middle



Cut all 14 parts from the two 1 x 10 boards using a circular saw. You won't have much scrap—just enough to get a bonfire started.



How a Chicago Doctor Shook Up the Hearing Aid Industry with his Newest Invention

New nearly invisible digital hearing aid breaks price barrier in affordability

Reported by J. Page

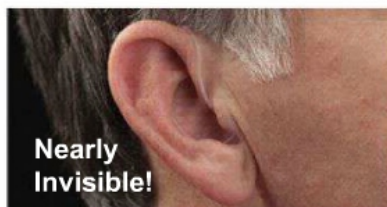
Chicago: Board-certified physician Dr. S. Cherukuri has done it once again with his newest invention of a medical grade **ALL DIGITAL affordable hearing aid.**

This new digital hearing aid is packed with all the features of \$3,000 competitors at a mere fraction of the cost. **Now, most people with hearing loss are able to enjoy crystal clear, natural sound—in a crowd, on the phone, in the wind—without suffering through “whistling” and annoying background noise.**

New Digital Hearing Aid Outperforms Expensive Competitors

This sleek, lightweight, fully programmed hearing aid is the outgrowth of the digital revolution that is changing our world. While demand for “all things digital” caused most prices to plunge (consider DVD players and computers, which originally sold for thousands of dollars and today can be purchased for less than \$100), yet the cost of a digital medical hearing aid remained out of reach.

Dr. Cherukuri knew that many of his patients would benefit but couldn't afford the expense of these new digital hearing aids. Generally they are *not* covered by Medicare and most private health insurance.



Nearly Invisible!

SAME FEATURES AS EXPENSIVE HEARING AID COMPETITORS

- ✓ Mini Behind-The-Ear hearing aid with thin tubing for a nearly invisible profile
- ✓ Advanced noise reduction to make speech clearer
- ✓ Feedback Cancellation eliminates whistling
- ✓ Wide dynamic range compression makes soft sounds audible and loud sounds comfortable
- ✓ Telecoil setting for use with compatible phones, and looped environments like churches
- ✓ 3 programs and volume dial to accommodate most common types of hearing loss even in challenging listening environments

The doctor evaluated all the high priced digital hearing aids on the market, broke them down to their base components, and then created his own affordable version—called the MDHearingAid® **AIR** for its virtually invisible, lightweight appearance.

Affordable Digital Technology

Using advanced digital technology, the MDHearingAid® **AIR** automatically adjusts to your listening environment—prioritizing speech and de-emphasizing background noise. Experience all of the sounds you've been missing at a price you can afford. **This doctor designed and approved hearing aid comes with a full year's supply of long-life batteries. It delivers crisp, clear sound all day long and the soft flexible ear buds are so comfortable you won't realize you're wearing them.**

Try It Yourself At Home With Our 45 Day Risk-Free Trial

Of course, hearing is believing and we invite you to try it for yourself with our RISK-FREE 45-day home trial. If you are not completely satisfied, simply return it within that time period for a full refund of your purchase price.

Can a hearing aid delay or prevent dementia?

A study by Johns Hopkins and National Institute on Aging researchers suggests older individuals with hearing loss are significantly more likely to develop dementia over time than those who retain their hearing. They suggest that an intervention—such as a hearing aid—could delay or prevent dementia by improving hearing!

“Satisfied Buyers Agree AIR Is Best Digital Value!”

“I am hearing things I didn't know I was missing. Really amazing. I'm wearing them all the time” —Linda Irving, Indiana

“Almost work too well. I am a teacher and hearing much better now” —Lillian Barden, California

“I have used many expensive hearing aids, some over \$5,000. The Airs have greatly improved my enjoyment of life” —Som Y., Michigan

“I would definitely recommend them to my patients with hearing loss” —Amy S., Audiologist, Munster, Indiana



MDHearingAid® **AIR**

**For the Lowest Price plus
FREE Shipping Call Today**

800-873-0541

**Phone Lines Open
24 Hours EVERY DAY**

**Use Offer Code AF95 to get
FREE Batteries for a Full Year!**
www.MDHearingAid.com/AF95



45 DAY
RISK FREE
TRIAL



Proudly assembled in the USA
from Domestic & Imported Components.



ITCHING TO FIX THAT SCRATCH?

See how easy it is to restore that like-new finish in just an afternoon. Watch our online how-to videos to show you how.



Paint pens
½ oz and 2 oz bottles
12 oz spray cans
Ready-to-spray pints,
quarts and gallons

Automotivetouchup.com
888-710-5192

PROJECT

Materials List

Part	Name	Qty.	Dimensions
A	Seatback	2	9¼" x 32"
B	Seat	2	9¼" x 20¼"
C	Front stretcher	1	5½" x 21¼" (beveled 30 degrees along one edge)
D	Back support	1	4" x 25¼" (beveled 30 degrees along one edge)
E	Front leg	2	4⅝" x 21¼"
F	Armrest	2	4⅝" x 28"
G	Rear leg	2	4⅝" x 32"
H	Arm support	2	3" x 11½" (tapered from 1½" to 3" along length)

of the board. For most saws that means setting the guide 1½ inches off-center. Attach the guide with a couple of screws; you can cut around the holes later [1].

Now chop all the parts to length according to the cut list.

Grab the piece you cut off the first board and rip it to 5½ inches at a 30-degree bevel. If you need a guide, clamp one of the armrests to the board. The wider piece is the front stretcher; the other is the back support.

Mark a 20-degree cut on the front end of each rear-leg blank. Place the pivot point of a rafter square on the top corner of the leg, and turn it clockwise so its 20-degree mark lines up with the edge of the board [2]. Cut along the line. On the back end of the leg, cut a 3 x 1-inch triangle off the bottom corner.

Create both arm supports with a single tapering rip. Mark the line, clamp the blank to a work surface, and carefully make the cut.

ASSEMBLE

I like to clamp parts together before I fasten them. That stops the pieces from slipping as I drive the screws. It's like having an extra set of hands.

Build the leg subassemblies. Attach each front leg to a back leg so that the top corner of the back leg is 14 inches off the ground. Hold a rafter square at 20 degrees against the edge of the front leg to ensure it's fastened at the correct angle. Attach with four screws.

Fasten the seat parts to the leg subassemblies. Set the front edge of the seat flush with the top corners of the rear legs, and keep a ⅛-inch gap between the two seat boards [3]. Attach the front

stretcher so its beveled edge slopes downward. Don't drive screws into the end grain of the rear legs but into the side grain of the front legs, where they'll hold better.

Fasten the tapered arm supports to the front legs, and attach the armrests so they overhang ¾ inch at the front and on the inside of the front legs. Drive two screws into each front leg, and two into each arm support.

Attach the back support, beveled side up, to the armrests. They should be spaced 18¾ inches apart with their ends flush with the outside of the back support. Keep the assembly square. Drive a couple of screws through each arm and into the back support, taking care not to blow out through the workpiece [4].

Install the seatbacks by driving two screws through each rear leg and three screws through each seatback and into the back support. Don't go too deep or you'll punch through the other side.

Finish the chair by trimming off the back outer corners of the armrests. ■

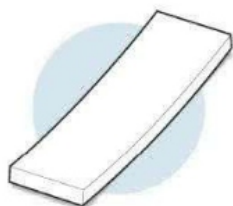


More projects at
popularmechanics.com/home.

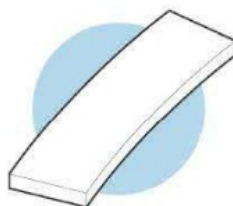
HOW TO AVOID CRAPPY LUMBER

To check for bows, crooks, and twists, place one end of the lumber on the ground and hold the other at eye level. Close one eye, and sight down the board to look for warping.

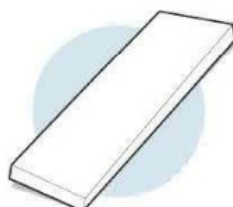
If you're cutting the lumber into smaller pieces, you can get away with slightly deformed boards. Otherwise, avoid anything warped 1/2 inch or more over a 10-foot length.



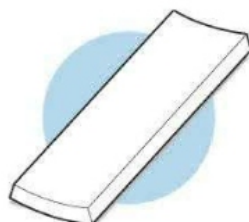
BOW
An end-to-end warp along the face of the board.



CROOK
An end-to-end warp along the edge of the board.



TWIST
Corners are out of alignment because of irregular warping.



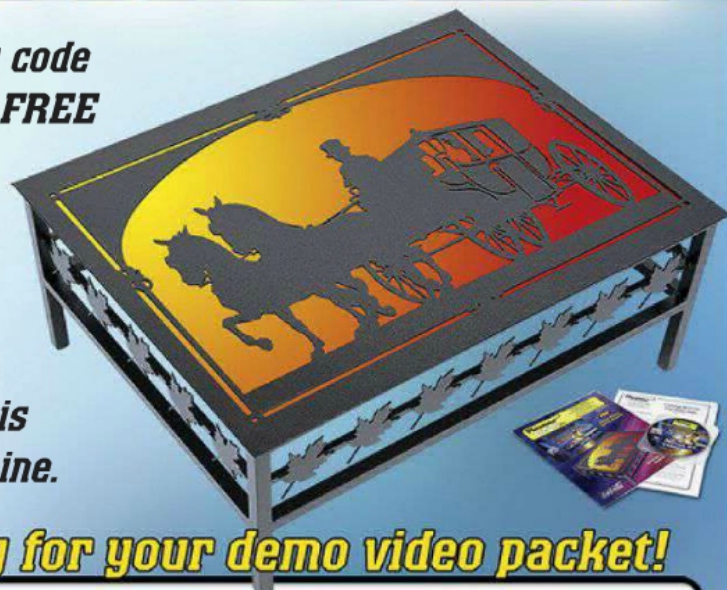
CUP
An edge-to-edge warp across the face of the board.

ILLUSTRATIONS BY GEORGE RETSECK



Cut Precise Metal Shapes In A Flash

Call with this code
G3BUR for a **FREE**
demo video
and catalog
show lots
of amazing
projects you
can cut on this
robotic machine.



Call today for your demo video packet!

PO Box 19818 • 5112 Graneros Rd.
Colorado City, CO 81019
www.plasmacam.com
(719) 676-2700 • fax (719) 676-2710

Plasma
CAM Inc.



The SUN Runs My Oven

Save the planet without leaving the house.

RENEWABLE
IT'S DOABLE

worldwildlife.org/solar

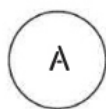


How to Make a Boat

CONTINUED FROM PAGE 81

right here," he says with a wide, easy smile. He says his family is only dimly aware of what he does most afternoons. "They don't really know nothing about Rocking the Boat. They don't know that I'm teaching," he says. His accent gives sharpness to the consonants of his English. "I wouldn't say we're not close, but we don't get to talking about it. I feel they aren't interested in my stuff." Sekou knows his secret life as a craftsman of hand-made wooden boats makes him unusual in Hunts Point. "This is making me way different from all my friends. They work in a clothes store. I build boats. It's impressive. I know that. It keeps me out of trouble."

He had moved out of his mother's apartment a month ago. He stared hard at the résumé in his hands for a long time, going over it and over it, hoping the piece of paper would convince an employer that his six years in the United States so far had been well-spent.



A boatswain is a ship's officer responsible for maintaining the ship's hull and equipment—rigging, anchors, and the like—but that is not where the *Boatswain* got its name. A former Rocking the Boat student and donor to the program named Melissa Mulcare Boatswain died of cancer last August at age 24. On launch day, a couple of her friends from the program speak about her, remembering her well. Her husband, Nigel, is here for today's maiden voyage, wearing a Rastafarian cap, white polo shirt, and jeans. He will be the first passenger on this vessel named for his wife.

Everyone lines up behind the band for the short walk to the dock. The boats sit on rolling dollies, and the students line up, six to a side, to guide them down to the water, steadying them on a straight course over the rocks and tufts

of grass. Friends and siblings of the students run ahead to take photos and videos with their phones. Once the crowd reaches the dock, Hannah Lynch, the energetic boatbuilding program director, wearing a brimmed hat and a work apron, picks up a bullhorn and quiets the crowd, her voice scratching out into the warm city air. It's one of the first really hot days of the year after an unrelenting winter. The program tries to teach the students to have a voice, to speak up, to not be shy, but this ceremony by the water is a little overwhelming for some of them. The neighbors and the grandmas and the parents and the local dignitaries clap, and one by one, as Lynch calls out the name of each graduating senior—all of whom will go to college in the fall—the students shuffle their feet in the dirt and smile at the ground.

Sekou pumps his giant arms in the air, cheering for each student whose name fills the air. His younger brother is with him today, the first member of his family to come see what Sekou has been doing all these days over all these years.

Lynch scoops some Bronx River water into a bottle and pours it over the bow of each boat, a christening. Then, as the students ease the dollies into the calm water at the river's edge, you can see the whole of the last 13 weeks on their faces. Every nail and screw, every shaving of wood, every frustration and satisfaction, every moment of discovery. These kids made two beautiful boats, and the boats made these kids. A small crew of students hops into each one, and they shove off into the water. Free. ■

POPULAR MECHANICS (ISSN 0032-4558) is published monthly except for combined July/August and December/January, 10 times a year, by Hearst Communications, Inc., 300 West 57th Street, New York, NY 10019 U.S.A. Steven R. Swartz, President & Chief Executive Officer; William R. Hearst III, Chairman; Frank A. Bennack, Jr., Executive Vice Chairman; Catherine A. Bostrom, Secretary; Hearst Magazines Division: David Carey, President; John P. Loughlin, Executive Vice President and General Manager; John A. Rohan, Jr., Senior Vice President, Finance. ©2014 by Hearst Communications, Inc. All rights reserved. Popular Mechanics is a registered trademark of Hearst Communications, Inc. Periodicals postage paid at N.Y., N.Y., and additional entry post offices. Canada Post International Publications mail product (Canadian distribution) sales agreement no. 40012499. CANADA BN NBR 10231 0943 RT. POSTMASTER: Send all UAA to CFS. (See DMM 707.4.12.5); NON-POSTAL AND MILITARY FACILITIES: send address corrections to Popular Mechanics, P.O. Box 6000, Harlan, IA 51593. Printed in U.S.A.

How to Make a Battery

CONTINUED FROM PAGE 95

form a company and five more to develop a prototype. Meanwhile the major battery makers have been marching inexorably forward, tweaking existing models to eke out more energy density. "With someone like Panasonic, every year their battery is a few percent better than the year before," says Paul Braun, a professor of materials science and engineering at the University of Illinois at Urbana-Champaign. "Compound that over 30 years and that's significant. With small companies and universities, the only way we're going to make an impact is if we provide two times or more better performance."

Braun is hoping to do just that, having spun off his research in porous, or nano-structured, anodes and cathodes into a company called Xerion. Though built differently from Prieto's, his battery also relies on the increased surface area and pathways for electrons and ions that come with using electrodes that aren't solid blocks. Braun believes that his lattice-like anodes and cathodes will provide double or triple the capacity and power of traditional lithium-ion batteries within 5 to 10 years—a common, and fairly ambiguous, time frame in this business.

One of the more successful battery startups, Amprius, is already selling its own nanostructured electrodes to phone makers, providing a 20 percent boost in capacity

to existing smartphones. But Amprius is currently at the conservative end of the battery race, using comparatively modest improvements to compete with established players.

Prieto Battery has a two-pronged approach to commercialization. Later this year the startup hopes to begin selling a more traditional drop-in anode that is safer, has three times the energy density, and can be swapped into standard Li-ion cells. Then there's the company's moon shot: the 3D battery whose fivefold increase in total power and nonflammable design could completely reinvent lithium-ion batteries.

FOR A MOON SHOT to work, the rockets need to fire. Or, in the case of Prieto Battery, the LED has to light up. The video that Johnson had Prieto watch at the Italian restaurant that night showed something like liftoff. The video was of the company's 3D battery prototype, and it was incontrovertible proof that they had cracked the final problem.

Complications with that polymer electrolyte—the conductive material between the anode and cathode layers—had essentially brought the battery's development to a halt. And all of a sudden the science was done. "That was really, really cool," Prieto says. "Once we made that breakthrough in the polymer electrolyte, I started realizing that this would actually work."

But it's early for Prieto and Johnson to declare victory. The challenges that

EDITORIAL & ADVERTISING

OFFICES:
300 West 57th Street,
New York, NY 10019-3797

SUBSCRIPTION SERVICES: Popular Mechanics will, upon receipt of a complete subscription order, undertake fulfillment of that order so as to provide the first copy for delivery by the Postal Service or alternate carrier within 4 to 6 weeks. >>> Subscription prices: United States and possessions: \$24.00 for one year. Canada and all other countries: \$40.00 for one year. >>> Should you have any problem with your subscription, please visit service.popularmechanics.com or write to Customer Service Department, Popular Mechanics, P.O. Box 6000, Harlan, IA 51593. Please enclose your mailing label when writing to us or renewing your subscription. >>> Popular Mechanics is not responsible for unsolicited manuscripts or art. None will be returned unless accompanied by a self-

addressed stamped envelope.

MAILING LISTS: From time to time we make our subscriber list available to companies who sell goods and services by mail that we believe would interest our readers. If you would rather not receive such offers via postal mail, please send your current mailing label or exact copy to Popular Mechanics, Mail Preference Service, P.O. Box 6000, Harlan, IA 51593. You can also visit <http://hearst.ed4.net/profile/login.cfm> to manage your preferences and opt out of receiving marketing offers by email.

AS A SERVICE TO READERS, Popular Mechanics publishes newsworthy products, techniques, and scientific and technological developments. Because of possible variance in the quality and condition of materials and workmanship, Popular Mechanics cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects resulting from information published in this magazine.

remain are of the daunting, startup variety. The biggest? Convincing larger companies to actually build Prieto's 3D batteries. Prieto has a head start, though. Her plan from the outset was to not only design a battery but to develop low-cost, highly modular manufacturing techniques to make it. The company has already created a small pilot production line in its lab space at CSU. The goal was to show companies how to tiptoe into production, as opposed to investing in a \$40 million plant.

Incredibly, this production line isn't a miniature clean room or outfitted with vapor traps to suck away hazardous fumes. Prieto's approach largely avoids the toxic chemicals found in standard Li-ion batteries—something she says is “a moral choice.” It's an environmental decision that also has potential economic benefits, cutting the expense associated with disposing of or recycling such materials.

Prieto can't share the names of the strategic partners that are showing interest, but she sees her battery's ultrastable chemistry as a perfect initial match for the military's unmanned submersibles, which can't use standard lithium-ion packs because of the fire hazard. And the company plans to get its 3D solid-state cells into a limited number of consumer applications by 2016.

These are the best-case scenarios, of course, and assume breakthroughs that have nothing to do with science. “You can imagine why this was challenging to pitch to investors in the beginning,” Prieto says. “On the one hand they want transformational approaches. But it is very hard to quantify, in terms of time and resources, how long it will take to make a major discovery.” Now there's no more guessing. “I'm really excited,” Prieto says. “The major discoveries are done.”

Which leaves her next-generation batteries where so many promising technologies ultimately lie: at the mercy of the people with the money. ■

An American Original!



STRONG • STICKY • WATERPROOF

Trust Duck® brand duct tape to deliver the quality and strength needed for every project.



DuckBrand.com

©ShurTech Brands, LLC 2014/57771

TECH CORNER by WeatherTech®

CARGOTECH™

CARGO CONTAINMENT SYSTEM



CargoTech™ is the newest innovative product released by WeatherTech®. This clever accessory couples a durable plastic fence with a super-grippy underside that stays stable on cargo liners, carpeting and flooring.

It is designed to help secure cargo from sliding throughout the cargo area including coolers, groceries, gym bags, sporting equipment and more.

Sold as a set of 4.

TO ORDER WeatherTech.com · 800-441-6287

©2014 MacNeil IP LLC

**500 Stores
Nationwide**

HARBOR FREIGHT

QUALITY TOOLS AT RIDICULOUSLY LOW PRICES

**LIFETIME
WARRANTY**
ON ALL HAND TOOLS!

How Does Harbor Freight Sell GREAT QUALITY Tools at the LOWEST Prices?

We have invested millions of dollars in our own state-of-the-art quality test labs and millions more in our factories. So our tools will go toe-to-toe with the top professional brands. And we can sell them for a fraction of the price because we cut out the middle man and pass the savings on to you. It's just that simple! Come visit one of our 500 Stores Nationwide and see why now more than ever...

**If You Buy Your Tools Anywhere Else,
You're Throwing Your Money Away!**

- We'll Beat Any Competitor's Price Within 1 Year Of Purchase
- No Hassle Return Policy
- 100% Satisfaction Guaranteed

NBODY BEATS OUR QUALITY, SERVICE AND PRICE

SUPER COUPON!

20% OFF

ANY SINGLE ITEM

LIMIT 1 - Save 20% on any one item purchased at our stores or HarborFreight.com or by calling 800-423-2567. *Cannot be used with other discount, coupon, gift cards, inside Track Club membership, extended service plans or on any of the following: compressors, generators, tool storage or carts, welders, floor jacks, Towable Side-On Trencher, Saw Mill (Item 61712/62365/67136), open box items, in-store event or parking lot sale items. Not valid on prior purchases after 30 days from original purchase date with original receipt. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.



SUPER COUPON!

FREE

PITTSBURGH
**6 PIECE
SCREWDRIVER
SET**
ITEM 47770/61313
Item 47770 shown

**\$4.99
VALUE**

WITH ANY PURCHASE

LIMIT 1 - Cannot be used with other discount, coupon or prior purchase. Coupon good at our stores, HarborFreight.com or by calling 800-423-2567. Offer good while supplies last. Shipping & Handling charges may apply if not picked up in-store. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.



SUPER COUPON!

**5000 LB. ELECTRIC WINCH
WITH REMOTE CONTROL AND
AUTOMATIC BRAKE**
LOT NO. 68144/61384/61605
Item 68144 shown

SAVE \$80
\$169.99
REG. PRICE \$249.99

30723006

LIMIT 5 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

**900 PEAK/
800 RUNNING WATTS
2 HP (63 CC)
GAS GENERATOR**
Item 69381 shown

SAVE \$80
\$99.99
REG. PRICE \$179.99

30722091

LIMIT 4 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

**17 FT. TYPE 1A
MULTI-TASK
LADDER**
LOT NO. 67646

• 300 lb. Capacity
• 23 Configurations

SAVE \$80
\$119.99
REG. PRICE \$199.99

30724105

LIMIT 3 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

WINNER ★ Truckin' Magazine
**26" 4 DRAWER
TOOL CART**
US - GENERAL
LOT NO. 95659
61634/61952
Item 95659 shown

• 580 lb. Capacity

SAVE \$180
\$99.99
REG. PRICE \$279.99

30709652

LIMIT 9 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

**14 HP, 30 GALLON, 180 PSI
TRUCK BED GAS POWERED
AIR COMPRESSOR
(420 CC)**
Item 69324 shown

SAVE \$800
\$999.99
REG. PRICE \$1799.99

30715889

LIMIT 5 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

**4-1/2" ANGLE GRINDER
drillmaster**
LOT NO. 95578
69645/60625
Item 60625 shown

SAVE 50%
\$9.99
REG. PRICE \$19.99

30664746

LIMIT 9 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

**POWDER-FREE NITRILE GLOVES
PACK OF 100**
• 5 mil. thickness
MEDIUM
LOT NO. 68496/61363

YOUR CHOICE!
LARGE
LOT NO. 68497/61360
X-LARGE
LOT NO. 68498/61359/37052

SAVE 40%
\$6.49
REG. PRICE \$10.99

30720772

LIMIT 9 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

**"The Undisputed King of the Garage"
- Four Wheeler Magazine**
PITTSBURGH
**RAPID PUMP®
1.5 TON ALUMINUM
RACING JACK**
Item 68053 shown

SAVE \$60
\$59.99
REG. PRICE \$119.99

30674566

LIMIT 5 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

**13 PIECE 1/2" DRIVE
DEEP WALL IMPACT SOCKET SETS**
SAE
LOT NO. 67903/69280
69333/69560
Item 67903 shown

METRIC
LOT NO. 67904/69279
69332/69561

SAVE 42%
\$19.99
REG. PRICE \$34.99

30498061

LIMIT 9 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

**1 TON CAPACITY
FOLDABLE
SHOP CRANE**
PITTSBURGH
Item 69512 shown

• Includes Ram, Hook and Chain

SAVE \$150
\$99.99
REG. PRICE \$249.99

69445/69512/93840/61858

LIMIT 4 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

**CHICAGO ELECTRIC WELDING
MIG-FLUX
WELDING CART**
Welder and accessories sold separately.
LOT NO. 69340/60790
90305/61316
Item 69340 shown

SAVE 40%
\$35.99
REG. PRICE \$59.99

30670388

LIMIT 3 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

**PACIFIC HYDROSTAR
1500 PSI
PRESSURE
WASHER**
LOT NO. 68333/69488
Item 68333 shown

SAVE \$50
\$79.99
REG. PRICE \$129.99

30679813

LIMIT 4 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

WINDSOR DESIGN

EIGHT DRAWER WOOD TOOL CHEST

LOT NO. 94538

SAVE \$30

\$69.99 REG. PRICE \$99.99

30780985

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

3 PIECE TITANIUM NITRIDE COATED HIGH SPEED STEEL STEP DRILLS

• Drill 28 Hole Sizes

SAVE 60%

Item 91616 shown

LOT NO. 91616 69087/60379

\$7.99 REG. PRICE \$19.99

30775656

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

10 FT. x 20 FT. PORTABLE CAR CANOPY

Item 69034 shown

LOT NO. 69034 68218/60728

\$99.99 **SAVE \$100** **\$149.99** REG. PRICE \$199.99

30777721

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

1500 WATT DUAL TEMPERATURE HEAT GUN (572°/1112°)

drillmaster

LOT NO. 96289 62340

Item 96289 shown

\$8.99 **SAVE 70%** **\$14.99** REG. PRICE \$29.99

30737558

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

1.5 HP ELECTRIC POLE SAW

OUTDOOR

SAVE \$30

• Extends from 6 ft. to 8 ft. 10"

LOT NO. 68862

\$69.99 REG. PRICE \$99.99

30736565

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

27 LED PORTABLE WORKLIGHT/FLASHLIGHT

LOT NO. 67227 69567/60566

Item 67227 shown

\$2.99 **SAVE 50%** REG. PRICE \$5.99

30726166

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

3/8" x 14 FT. GRADE 43 TOWING CHAIN

HaulMaster

Item 97711 shown

LOT NO. 97711/60658

\$24.99 **SAVE 44%** REG. PRICE \$44.99

30753188

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

FOLDABLE ALUMINUM SPORTS CHAIR

LOT NO. 66383/62314

Item 66383 shown

\$24.99 **SAVE 37%** REG. PRICE \$39.99

30774805

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

10 TON HYDRAULIC LOG SPLITTER

OUTLET MACHINERY

LOT NO. 67090/62291

Item 67090 shown

\$119.99 **SAVE \$55** REG. PRICE \$149.99

30761557

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

1-1/4 GALLON SPRAYER

LOT NO. 95692/61280

Item 95692 shown

\$8.99 **SAVE 43%** REG. PRICE \$15.99

30754828

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

1195 LB. CAPACITY 4 FT. x 8 FT. HEAVY DUTY FOLDABLE UTILITY TRAILER

HaulMaster

Item 90154 shown

LOT NO. 90154/62170

\$269.99 **SAVE \$130** REG. PRICE \$399.99

30730810

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

90 AMP FLUX WIRE WELDER

• No Gas Required

LOT NO. 68887 61849

Item 68887 shown

\$99.99 **SAVE \$50** REG. PRICE \$149.99

30731596

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

10" PNEUMATIC TIRE

HaulMaster

Item 30900 shown

LOT NO. 69385/62388

\$3.99 **SAVE 60%** REG. PRICE \$9.99

30774069

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

RETRACTABLE AIR HOSE REEL WITH 3/8" x 50 FT. HOSE

CENTRAL PNEUMATIC

Item 93897 shown

LOT NO. 93897 69265/62344

\$64.99 **SAVE \$65** REG. PRICE \$129.99

30725585

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

TRIPLE BALL TRAILER HITCH

LOT NO. 61913 94141 69874 61320 61914

Item 94141 shown

\$19.99 **SAVE 66%** REG. PRICE \$59.99

30747873

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

SUPER-WIDE TRI-FOLD ALUMINUM LOADING RAMP

LOT NO. 90018 69595/60334

Item 90018 shown

\$89.99 **SAVE \$60** **\$99.99** REG. PRICE \$149.99

30755261

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

8" 5 SPEED BENCH MOUNT DRILL PRESS

CENTRAL MACHINERY

Item 60238 shown

LOT NO. 44506/60238/62390

\$54.99 **SAVE \$45** REG. PRICE \$99.99

30729239

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

SUPER COUPON!

AUTOMATIC BATTERY FLOAT CHARGER

LOT NO. 42292 68594/69955

Item 42292 shown

\$5.99 **SAVE 60%** REG. PRICE \$14.99

30730125

LIMIT 8 - Good at our stores or HarborFreight.com or by calling 800-423-2567. Cannot be used with other discount or coupon or prior purchases after 30 days from original purchase with original receipt. Offer good while supplies last. Non-transferable. Original coupon must be presented. Valid through 12/5/14. Limit one coupon per customer per day.

Order at HarborFreight.com or 800-423-2567

We FedEx Most Orders in 24 Hours for \$6.99

Customers and Experts Agree Harbor Freight WINS in QUALITY and PRICE

How to Make Bread

CONTINUED FROM PAGE 103

During this time the yeast is again fermenting and, in a way, working the dough from within. Carbon dioxide slowly inflates the air pockets in the dough, stretching them and continuing gluten development (this is when Robertson turns the dough). A matrix of gluten that will be the basis for the baked bread forms, and in this first, crucial rise, the dough doubles in volume.

"We let it rise for a few hours," I told my mother. "Then we're supposed to shape it into loaves, and it rests again. Then it goes in the fridge overnight." That final fermentation, or proof, used to be fairly short in the old days, but with the advent of widely available refrigeration in the 1920s, bakers discovered yeasts took 10 times longer to rise in the refrigerator than at room temperature, and thus an overnight rise became a possibility.

This is how Robertson can sleep. A baker tests the dough after this rise by poking it with a finger. If it holds the shape for a while, that means the gluten has reached the limit of its elasticity and is ready for baking. For us that would not happen until the next morning.

"Well, there's certainly a lot of free time in baking!" my mother announced, her eyes sparkling. "Should we have a gin and tonic?"



WHAT HAPPENS DURING THE baking is fascinating. The presence of steam is essential—it accelerates the heat transfer from the hot oven to the dough and prolongs the forming of crust, allowing an elastic rise

called the oven spring. It is dramatic. Yeast is no longer the prime mover here. Alcohol, fermentation's other byproduct, and water vaporize within the air pockets, expanding the dough to as much as half again its initial size. After 6 minutes or so the crust begins to form, cutting off any further rise. The air pockets continue to expand, however, and burst their walls, creating an interconnected network of passageways like a sponge's. If they did not burst, those little pockets would simply deflate upon cooling. The loaf would collapse. Why does a baker tap a loaf to see if it's done? Because only if it has cooked thoroughly, the pockets bursting to become a porous sponge, will it ring with the hollow sound of perfectly baked bread.

My mother does not have professional ovens like Robertson's. She got up at 5:30 in the morning to remove the rounds from the fridge and let them sit and rise some more, but

we were left with a quandary: how to bake them. A conventional oven cannot hold the extreme temperatures long enough, and my mother doesn't own the pizza stone called for in the recipe. So she went out into the yard, pried up two bricks from the patio, wrapped them in aluminum foil, and put them in the oven. "There," she said, smiling. "It doesn't matter. It's just about heat retention."

We made shallow cuts in the rounds, slid them into the 500-degree-Fahrenheit oven, sprayed them with water, and closed the door. I was a nervous wreck; everything about them looked wrong. Even that morning, after a few hours of extra fermentation, they would not hold an indentation the way the book said. But as I watched through the little window, it happened. They grew incredibly. In about half an hour they were golden brown, with an internal temperature of 210. "Mom!" I yelled. "Mom, the bread is ready!"

They looked a little pale. I sliced one open, expecting the worst. We each took a piece, spread butter on it, and tasted. It was delicious. Not spectacular, but crusty and soft. It was my very first loaf of bread. And, it turns out, also my mother's. "Oh, I made biscuits, like your grandmother, but not *this*," she said. She stood and smiled at me, in her clear, searching way. "It's amazing," she said after a moment, "that these single-celled creatures can make such a thing. A miracle."

At Tartine, with a strongman's shove, one by one, Robertson has rolled the loaves into the oven, the doors closing automatically behind them. Then he turned and smiled as he pressed the button that injects steam. How many loaves has he baked? A thousand? Ten thousand? There was no sign of routine, no boredom in his art. No sign of falling out of love.

The loaves come out of the oven chocolate-brown, with streaks of flour. The cuts have blossomed on top, and the

LIVE YOUR DREAM! Train online for a new career.

Enjoy the freedom and challenge of being your own boss. Enroll in one of our professional training programs and graduate ready to make a good living in your own business.



Why Ashworth College?

- Study online at your own pace
- Learn practical, on-the-job skills
- Affordable, 0-interest tuition

What You Get

- Complete study guides, books and online exams
- Personal academic support
- CareerBuilder® services

Auto Mechanics. Learn the inner workings of automotive systems as recommended by the **National Automotive Technicians Education Foundation** with exciting animations and lab simulations.

Electrician Training. Content covers basic wiring techniques, circuitry, reading blueprints, appliance repair and more, in compliance with the **National Electrical Code**.

Home Inspection. Get foundation to rooftop training. Learn to inspect walls, windows, doors, basements, crawl spaces and utilities.

Locksmithing. Step-by-step techniques show you how to work with manual and electric lock systems for residences, businesses and vehicles.

Explore all of our accredited online career training and degree programs.

Call **800.873.3934** or enroll at
LearnAtAshworth.com today!



Ashworth College is nationally accredited by the Accrediting Commission of the Distance Education and Training Council, recognized by the U.S. Department of Education.



ASHWORTH
COLLEGE

© 2013 Ashworth College. All rights reserved.

snips on the porridge loaves have baked into stegosaurus spines. Robertson has been checking them throughout the morning, noting that one looked "funny," and on the last check his face became serious as he went into action: swiftly pulling them out with a long wooden paddle, placing them sideways on a black wire rack to cool. You can almost hear the crackle as their crusts contract.

"Do you ever have failures?"

He laughs and looks at the floor with a smile, adjusting his cap—a potter asked if he ever drops a bowl.

A friend had advised me to sneak my starter to Tartine and, like some wicked child in Wonka's factory, surreptitiously open it to steal a little of whatever magic is in the place. But I now know there is no magic. At Tartine Robertson is making precisely the bread I made with my mother. But while our bread was good, engineered by careful bakers to work every time, Robertson's new breads are sometimes failures, sometimes extravagant successes, and the difference is not the ingredients—there are, after all, only four—but the curiosity it takes to use them to our ends. He hands me a brown paper bag: in it, a loaf of kamut porridge. We chat for a moment about music, and then he shakes my hand and wishes me luck, then heads to the back. My mind is only on the bread. I am barely out the door before I dig in: It is warm, luscious, nutty. I can't stop eating it.

My mother was right: It is amazing that creatures could make such a thing. But not the yeast, though those creatures are amazing too. The humans. We have groped our way from discovery to discovery—from Stone Age flatbreads to Egyptian leavened ones, from mortars and pestles to Mesopotamian grinding stones—forging an arduous path toward a food that today is the embodiment of the everyday, a food any fool can make. ■

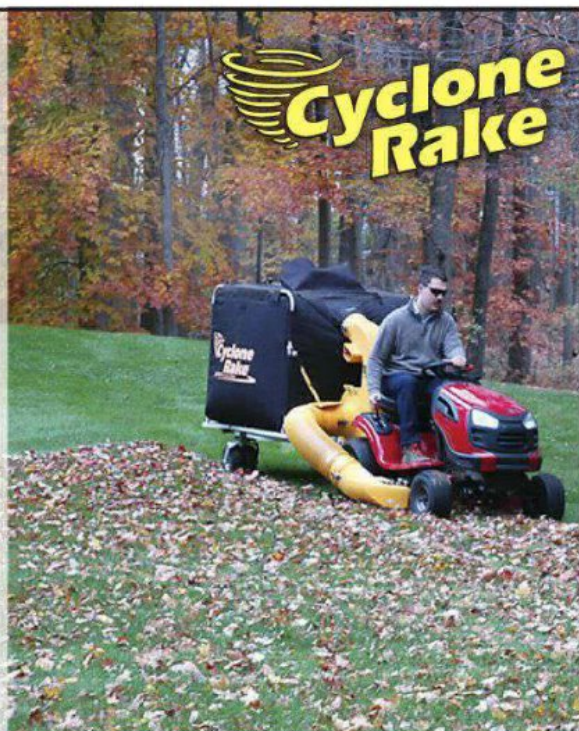
SAVE TIME & YOUR BACK!

The amazing power of the Cyclone Rake leaf and lawn vacuum makes Fall property cleanup quick and easy.

With its engine-driven JetPath® Vacuum System and patented miracle impeller, all of your leaves and debris will be collected and mulched in a single pass.

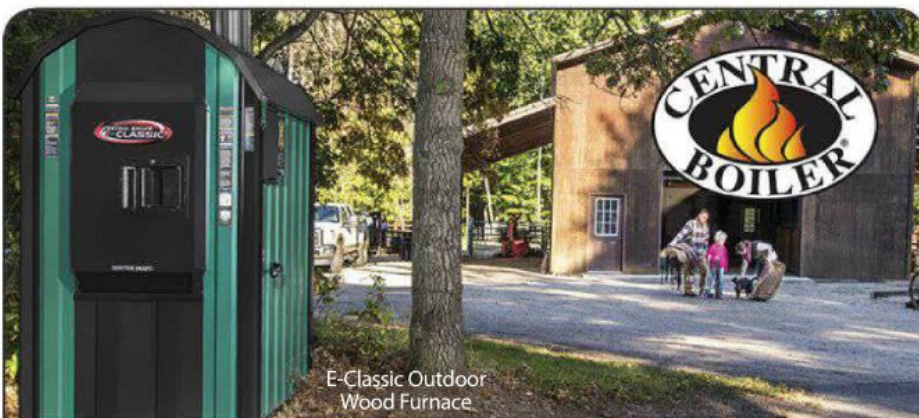
It hitches to nearly any riding mower or ZTR and it's backed by our **ONE YEAR RISK-FREE TRIAL**. If you don't like it, send it back for a full refund!

©Woodland Power Products, Inc.,
72 Acton St., West Haven, CT 06516



REQUEST A FREE, CATALOG AND DVD
Call: 1-800-315-4073
Visit: CycloneRake.com

Use Discount Code **PM914** when you call, or enter it on our website for a special discount on any Cyclone Rake purchased by 12/30/2014.



How to stop paying high heating bills.

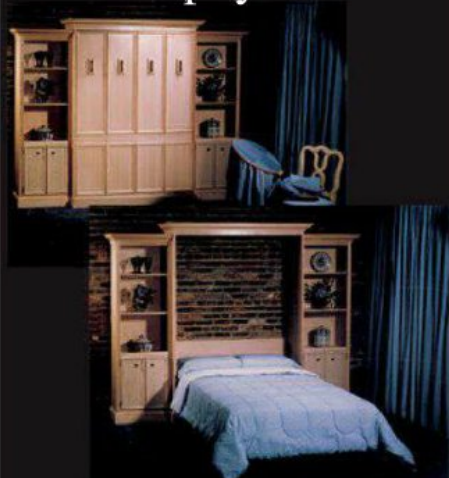
Families that heat their homes with an E-Classic outdoor wood furnace take pride in knowing they are saving thousands of dollars annually on heating bills. They have more time to do family things because the E-Classic's efficient design and operation can use up to 50% less wood than traditional wood heating. With energy prices skyrocketing, how much could you save if you were able to heat your entire home, water and more with an E-Classic outdoor wood furnace? Contact your nearest Central Boiler dealer today to find out.

Visit **CentralBoiler.com** or call **(800) 248-4681** for the dealer nearest you.



All E-Classic outdoor wood furnaces adapt easily to new or existing heating systems. It's important that your outdoor furnace and system be properly sized and installed. See your local dealer for more information. ©2014 Central Boiler • ad6669

Need more space?
Build your own
murphy bed.



Piston-lift
mechanism kit
includes
step-by-step
construction plans
and instructional
DVD

Create-A-Bed®

Toll Free 1-877-966-3852
www.wallbed.com

IP PATENT SERVICES

Affordable - Confidential
USPTO Reg. No. 66,771
(707) 473-8295 cpilling.com

A "K" Original folded one dollar ring.



Guaranteed to love them.
Been making them over
40 years and never a
complaint. Send \$6 & \$1
for S&H total \$7 to
Memorek P O Box 386
Provo Utah 84603

FREE REPORT

Waterwisdom®

\$1500
Value

Truth revealed about distilled, mineral, spring,
reverse osmosis, bottled, alkalized & more...

800-874-9028 waterwise.com/pm

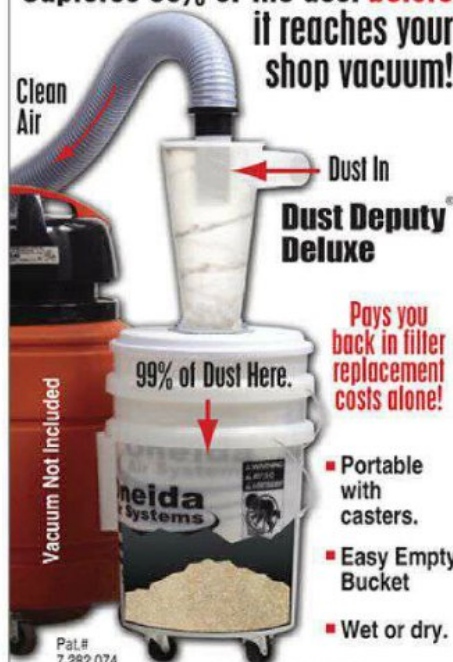
© 2012 Waterwise Inc

Droid TV
Streaming Media Player
Watch Your Favorite
TV Shows, Movies and More,
All for FREE!
888-712-7944
www.droid-tv.net

...Awesome Product!

- J. Denison

Captures 99% of the dust **before**
it reaches your
shop vacuum!



Dust Deputy
Deluxe

Pays you
back in filter
replacement
costs alone!

- Portable
with
casters.
- Easy Empty
Bucket
- Wet or dry.

Pat.#
7,282,074



Made in
the USA



Like f

Call for Information!
800.732.4065

Order Online
www.oneida-air.com

BURNTABLES

The Affordable CNC Table That Does It All



Dream It, Design It, Burn It

Start Your Own Business In
Metal Art Or Fabrication

COMPLETE TURN-KEY CNC TABLES

- Affordable Prices
- Industrial Grade
- Easy To Use

Starting At
\$6,800!



www.BurnTables.com

2 SEAT BIKE

Drives like a car

- Easy to Pedal
- Multi-Speed
- 1, 2 & 4 Seaters
- Optional Electric Motor



Models starting at \$1354

For a FREE brochure call

RHOADES CAR
1-888-518-4960 Ext. 8686
www.RhoadesCar.com

1.888.518.4960 Ext. 8686
www.RhoadesCar.com

www.motionmodels.com

THE WORLD'S FINEST READYMADE AND CUSTOM TRUE MUSEUM
QUALITY AIRPLANE AND NAVY AND COAST GUARD SHIP MODELS



USS GEORGE H.W. BUSH CVN-77 CUSTOM MADE
FOR NORTHROP GRUMMAN AND PRESIDENT BUSH



MOST NAVY AND COAST GUARD SHIPS AVAILABLE



www.motionmodels.com

1-800-866-3172

NATURE CLEANS OUR AIR



Did you know that trees absorb

1/5

of carbon emissions?

Sixty years ago, The Nature Conservancy's first act
was conserving a forest in New York. Today, we
help people all over the world to protect the life-
giving services their forests provide.

Help nature to breathe easier.

Learn how at nature.org.



Protecting nature. Preserving life.

GPS Tracking For What's Important

- Plugs right into your vehicle
 - Real Time GPS Tracking & Alert Technology
- GPS Trackers starting at \$99.00
- www.birdseyetracking.com • 1-877-55-MYTRACK

TerraTrike

Explore your world.
Get out and ride.

FREE CATALOG: 800-945-9910 www.TerraTrike.com

UNCLOG DRAINS

with your
Pressure Washer

100 Ft. Sewer Jetter
ONLY \$129

\$10 OFF
GIFT CODE: PM92

ClogHog.com
877.992.5644

Made in the USA

DR. COLORCHIP™
AUTOMOTIVE PAINT CHIP REPAIR SYSTEMS

Can Your Touch-Up Paint Do This?

BEFORE AFTER

Fast, Simple, Dramatic Paint Chip Repairs
...with **NO PAINT BLOBS!**

Step 1 - Dab

Step 2 - Smear

Step 3 - Blend

- All Factory Match Colors
- Permanent Chip Repairs
- No Clear Coat Needed
- The Cure for Road Rash

3 kit sizes: \$39.95 - \$59.95

Rated #1 by *The Wall Street Journal* among do-it-yourself paint repair products

See our website for photos & video demonstrations

Order Your Paint Chip Repair Kit Today!

Drcolorchip.com (866) 372-2548

ELITE

Save Over 80%

\$29.95

Compare similar \$158.20

- 15 Premium Hand-Rolled Cigars
- Cherrywood-finish Humidor (Holds 20)
- An Ultra Reliable Butane Torch Lighter
- A Guillotine Cutter

Order Now Limited Supply

©1915 THOMPSON & CO., INC.

©2014 Thompson Cigar Co.

Add \$4.95 for Shipping - #884245. One per customer, Florida residents ADD 7% sales tax, not available to minors and good only in the USA

Call 1-800-541-8783
www.thompsons specials.com
Promo Code **TA090** • OFFER GOOD FOR 30 DAYS

LANSKY®
SHARPENERS

OUTDOOR KITCHEN SHOP

MASTER'S EDGE™
Knife Sharpener

Sharpens Straight & Serrated Knives

Learn more at **lansky.com**
800-825-2675 for FREE catalog Dept. POM

5-Minute Fence Stain



- Stain 100 ft of fence in just 5 minutes!
- Sprayer attaches directly to garden hose.
- No masking, simply hose off over-spray.
- One quart covers 600 square ft.
- Select from three natural wood tones; Natural Cedar, Dark Cedar or Redwood.

FiveMinuteFence.com

A FEW THINGS YOU DON'T NEED TO KNOW HOW TO MAKE

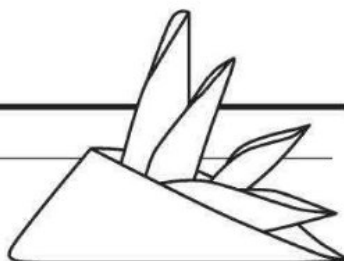
A Napkin in the Shape of a Bird of Paradise

1. Fold a cloth napkin in half twice to form a square, then fold it diagonally to form a triangle.

2. Rotate the napkin so that the open tip of the triangle points away from you. Fold the right corner down against the center line of the napkin.

Repeat with the left corner. You should have something that looks kind of like the shape of a diamond.

3. Tuck the overhanging edges underneath to form a triangle again, then fold the triangle in half so the lower two corners meet.



4. Pinching the folded corners together, pull up the four flaps of napkin tucked inside the open corner of the triangle.

The Perfect Party Playlist

1. Check the guest list to determine the mix of male and female attendees. Men tend to prefer mellow rock, folk, or, if the average age is over 45, jazz. For whatever reason, women seem to love Top 40.
2. Consider the occasion. For dinner parties choose classical or old Dylan. Anything else, up the tempo.
3. Consider the venue. Is it a big room? You can go more aggressive with your choices. In a small room you want to choose something unobtrusive.
4. Stage smooth transitions. You would never go from Katy Perry's "Roar" to John Prine's "(We're Not) the Jet Set." When in doubt, My Morning Jacket always offers a highly versatile segue.
5. If you're going to play multiple songs from the same artist, space them out by at least seven songs. Rarely should you include songs from the same album.
6. Include twice as many songs as you think you'll need.

GUNPOWDER FROM YOUR OWN URINE

- Fill a 300-gallon cement tank with manure and urine. If necessary, add a little water to fill things out. Wait 10 months, then strain the result through a fine sieve and a purifying layer of ashes, and dry the liquid portion on trays in the sun to create saltpeter.
- Grind the results into a fine powder with a mortar and pestle. After cleaning the mortar and pestle, grind standard charcoal briquettes into powder. Clean the mortar and pestle again, and grind elemental sulfur (found at garden stores) into a powder. • Mix 10 parts saltpeter with three parts charcoal and two parts sulfur. Grind together with the mortar and pestle for 10 minutes.

MIDORI SOUR

Ingredients:

- 1.5 ounces Midori melon liqueur
- 1 ounce vodka
- 2 ounces sour mix
- 1.5 ounces fresh lime juice
- 1 dash Sprite
- 1 maraschino cherry

Combine ingredients over ice and garnish with a cherry or lemon.



Vegan Fried Chicken

PREP TIME: 15 minutes

COOK TIME:

1 hour 30 minutes

124SERVES: 6

INGREDIENTS

Seitan:

- 1½ cups vital wheat gluten
- 1 teaspoon garlic powder
- 1½ teaspoons cumin
- ½ teaspoon salt
- ½ teaspoon pepper

Broth:

- 5 cups water
- 2 tablespoons soy sauce
- 2 tablespoons vegan Worcestershire sauce

Breading:

**MORE MILES.
MORE SAVINGS.**

\$50*

REBATE

VISA® PREPAID CARD

*By mail-in rebate with purchase of 4 ZE950
tires valid 08/01/14 through 09/30/14.
Restrictions apply.



ZIEX ZE950 A/S
ALL-SEASON HIGH PERFORMANCE



Start your summer right with a great rebate when purchasing a set of four ZIEX ZE950 tires from Falken. The new ZE950 featuring our exclusive Dynamic Range Technology, is the perfect replacement tire for your vehicle offering multiple sizes, long lasting treadwear, all-season performance and excellent value.

Learn more at: falkentire.com/moremiles

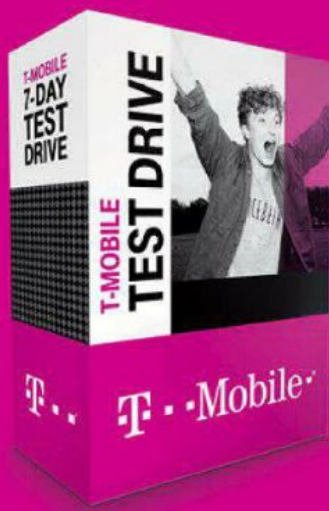


FALKEN
TIRE
WE GET YOU GOING.™



IT'S TIME FOR A JOY RIDE

TAKE THE T-MOBILE TEST DRIVE



We'll give you 7 days, **FREE**, to see how much you can download, post and stream.

Test drive the Data Strong™ network.

T-MOBILE.COM/TESTDRIVE



#TestDrive •



Phone is for trial use only. Limit one trial per card and per address. Phone must be returned in good working order to a T-Mobile store within 7 days of delivery to avoid charge for phone and tax. Credit or debit card required for trial; T-Mobile may place a hold on your card at the time you request a device. See website linked above for offer details. T-Mobile and the magenta color are registered trademarks of Deutsche Telekom AG. ©2014 T-Mobile USA, Inc.